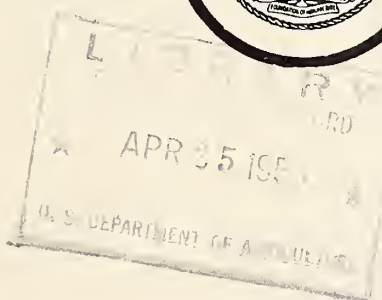


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UNITED STATES DEPARTMENT OF AGRICULTURE

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Agricultural Research Service

December 1955

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SOIL SCIENCE (BASIC)

Soil Physics

MOVEMENT OF WATER AND CHLORIDES IN RELATIVELY DRY SOIL

By T. J. Marshall and C. G. Curr. Soil Sci. 77: 147-152. 1954.

Movement of chlorides was measured in soil packed in shallow cups from which water was allowed to evaporate. Chlorides moved from the lower to the upper halves of the cups in soils that were as dry as the wilting percentage. From the evidence of chloride movement, it is concluded that water can move in the liquid phase throughout the whole range in which it is available to plants.

AN INFILTRATION EQUATION WITH PHYSICAL SIGNIFICANCE

By J. R. Phipp. Soil Sci. 77: 153-157. 1954.

An approximate equation is developed which relates infiltration to the physical determinants of the system. This equation gives quantitative explanation of aspects of infiltration.

The approach of Klute is generalized and used to obtain the condition for hydraulic similitude between prototype phenomena and unsaturated movement of water in the liquid phase and models employing the same medium but a liquid other than water.

ON THE HYDRAULIC CONDUCTIVITY OF UNSATURATED SOILS

By S. Irmay. Amer. Geophys. Union Trans. 35: 463-467. 1954.

Unsaturated steady flow of mixtures of a liquid and a gas through sands and similar porous media at low Reynolds numbers obeys Darcy's law. The relative liquid permeability K is not constant, but a universal function of the degree of liquid saturation. An approximate theory gives its form, which is a cubic parabola. A similar expression is found for the gas permeability. Numerous experiments by Wyckoff and Botset confirm the theory.

This is in agreement with Gardner's hypothesis that K is a function of the concentration in water, and indirectly with Richards' hypothesis that it is a function of the capillary potential. The degree of liquid saturation seems to be a more useful unit of liquid percentage than any other.

LEACHING LOSSES, RUNOFF AND PERCOLATION FROM EIGHT ILLINOIS SOILS

By R. S. Stauffer and R. H. Rust. Agron. Jour. 46: 207-211. 1954.

The results of this study indicate that leaching losses from soils are lower than was previously believed. Leaching losses, runoff, and percolate from soils differ widely depending on the characteristics of the soils. Generally, leaching losses from soils are found to correlate with amount of percolate but in this study this was not always true.

Sodium losses are more significantly related to the amount of percolate on the older, more mature soils than on the younger, less developed soils. The loss of cations, compared with the loss of anions, is relatively higher from those soils having free carbonates present in the lower part of the profiles on both loess-derived and till-derived soils.

EVALUATION OF THE ACCURACY OF FIBERGLAS-GYPSUM BLOCKS FOR MEASURING SOIL MOISTURE CHANGES

By J. M. Stackhouse and R. E. Youker. Agron. Jour. 46: 405-407. 1954.

Soil-moisture data have been obtained during periods of depletion and accretion by fiberglas-gypsum blocks and compared with those obtained from weight changes on weighing-monolith lysimeters.

Data for June 23 to September 3 show, with one exception, close agreement between the two methods was obtained regardless of whether soil moisture was increasing or decreasing. Data were also presented for three rainless periods. These indicated the amount of soil-moisture depletion, as measured by fiberglas-gypsum blocks, checked very closely with data obtained from weighing lysimeter Y102C.

INFLUENCE OF FILTER-PRESS CAKE ON PINEAPPLE YIELDS AND SOIL PROPERTIES

By M. A. Lugo-Lopez, E. Hernandez-Medina, H. R. Cibes-Viade, and J. Vincente-Chandler. Soil Sci. 78: 257-265. 1954.

Data from two field experiments located at typical pineapple growing areas in the

northern and interior regions of Puerto Rico are reported here. At one location (Arecibo) pineapple plants grown in soil receiving 32 tons of filter-press cake in addition to 1,500 pounds of a 12-6-10 fertilizer to the acre produced as high yields and as large fruits as plants grown in soil receiving twice as much fertilizer but no filter-press cake. Omission of nitrogen or of filter-press cake resulted in reduced yields.

At the second place (Corozal) 3,000 pounds of fertilizer in addition to 32 tons of filter-press cake to the acre was necessary for maximum yields. Omission of either potash or nitrogen is detrimental to pineapple production.

In Situ MEASUREMENT OF SOIL BULK DENSITY

By J. A. Vomocil. Agr. Engin. 35: 651-654. 1954.

This paper describes a new method for making rapid measurements of bulk density of soil. The method does not require the removal of a large sample. It takes advantage of the properties of a radioactive material for measuring purposes.

UNSATURATED FLOW OF WATER IN FIELD SOILS AND ITS EFFECT ON SOIL MOISTURE INVESTIGATIONS

By J. S. Robins, W. O. Pruitt, and W. H. Gardner. Soil Sci. Soc. Amer. Proc. 18: 344-347. 1954.

Measureable drainage of water within the soil profile in field plots was observed for periods of up to 8 days following irrigation under an actively transpiring alfalfa crop. Rates of movement from the 0- to 3-foot zone were of the order of 0.20 inch per day 2 days after irrigation and 0.11 inch per day 4 days after irrigation. Total drainage from the 0- to 3-foot zone for the period 2 to 8 days was 0.58 inch.

This downward movement of water is shown to have a material effect upon consumptive-use measurements and the soil-moisture extraction pattern. A computed error of 23 percent in consumptive use for the first 8 days following irrigation is shown to have occurred in the present experiment as a result of drainage from the 0- to 3- foot zone.

SIMPLE DIFFUSION WELL FOR MEASURING SOIL SPECIFIC DIFFUSION IMPEDANCE AND SOIL AIR COMPOSITION

By C. H. M. van Bavel. Soil Sci. Soc. Amer. Proc. 18: 229-234. 1954.

Straight, cylindrical tubes, open at the lower end and inserted into the soil can serve a dual purpose. Measurement of the re-entrance of oxygen into the tubes after they have been flushed with nitrogen permits calculating specific diffusion impedance of the soil. Charts for computing purposes are given. Measurement of the composition of the gas in the well, after a suitably long equilibrium time, is a convenient means for measuring the composition of the soil air at the depth of insertion of the well.

The physical and mathematical aspects of the method are briefly presented, and experimental proof is offered for the formulas that are derived.

SOME EMPIRICAL RELATIONS OF SOIL MOISTURE TENSIONS

By W. M. Miller. Soil Sci. Soc. Amer. Proc. 18: 239-243. 1954.

An analysis was made to compare methods of designating soil-moisture tension for an entire irrigation season. Using the field data from a sugar-beet irrigation experiment, seasonal values for soil-moisture tension at a given depth were calculated as a simple mean of all readings, and as a mean of the tensions just prior to each irrigation.

These values were found to correlate closely with mean tensions calculated similarly to Taylor's mean integrated tension for a single depth. Yields were found to correlate equally well with either mean integrated tension or the mean of tensions prior to irrigation. Under soil and growth conditions encountered, no advantage was found in using mean integrated soil-moisture tension or the arithmetic mean of all readings, in preference to the simpler mean of preirrigation tensions.

PERMEABILITY AND INTAKE RATES OF MEDIUM TEXTURED SOILS IN RELATION TO SILT CONTENT AND DEGREE OF COMPACTION

By C. H. Diebold. Soil Sci. Soc. Amer. Proc. 18: 339-343. 1954.

From 1948 through 1953, percolation rates were determined for 215 medium-textured layers of soil from farmland in Arizona, Colorado, New Mexico, and Utah. Knowledge of the differences in percolation rates are helpful in establishing soil treatment units. This knowledge helps to indicate those areas most apt to be damaged by overirrigation, feasibility of reclaiming saline and alkali affected soils, and to design effective drainage systems. Water-intake rates for these layers of soil at field moisture were determined for the first 2 hours. Often they were compared with either irrigation-intake rates or infiltrometer values. Thus, it was possible to locate not only limiting layers but also to develop clues for soils with different intake rates. The results were helpful in grouping soil units which have similar requirements for irrigation layouts and tillage practices.

Medium-textured soils, containing less than 2.5-percent organic matter but more than 40-percent silt, behaved like silt loams and had slow permeability and intake rates. In contrast, medium-textured soils which contained less than 40-percent silt had moderate permeability and moderate intake rates unless the soils were compact and had few effective pores. Both permeability and intake rates varied with compaction of the soil. Three degrees of compaction or bulk density appeared to be significant. However the limits for classes of bulk density were higher for sandy loams, sandy clay loams, and loams containing less than 40-percent silt than for the loams and silt loams containing 40-percent or more silt. Direction of natural breakage, especially in firm soils, and the number of effective pores per square foot were also important clues in evaluating permeability and intake

rates. Each of these clues must be considered with reference to the others.

FIELD CAPACITY APPROXIMATIONS BASED ON THE MOISTURE-TRANSMIT- TING PROPERTIES OF THE SOIL

By R. J. Hanks, W. E. Holmes, and C. B. Tanner. Soil Sci. Soc. Amer. Proc. 18: 252-254. 1954.

A new field-capacity approximation is reported. This approximation was compared both with the field capacity and with various estimates of the field capacity of 23 soils. The field-capacity approximation is related to the field capacity by the equation: $FC = 0.959FCA + 1.17$. The data support the view that field capacity is the moisture content of a well-drained soil, when, after the soil has been thoroughly wet, drainage has decreased the moisture content to such an extent that the consequent decrease in capillary conductivity materially impedes further drainage of water. A statistical test of significance showed that the field-capacity approximation is a significantly better overall estimate of field capacity than the moisture equivalent, Buchner funnel percentage, and 1.3-atm. percentage. The field-capacity approximation is not a significantly better estimate of field capacity than a modification of the Wilcox method. However, the field-capacity approximation is much more convenient, reproducible, and time conserving than the modified Wilcox method.

WATER-STABILITY OF AGGREGATES FROM POTATO PLOTS AS AFFECTED BY DIFFERENT ROTATION SYSTEMS UNDER IRRIGATION IN WESTERN NEBRASKA

By A. P. Mazurak, V. T. Valassis, and L. C. Harris. Soil Sci. Soc. Amer. Proc. 18: 243-247. 1954.

A series of crop-rotation plots under irrigation were established in 1912 on Tripp very fine sandy loam. From the series of rotations, potato plots were selected for the study of water-stability of aggregates: (1) continuous cropping of potatoes, (2) 3-year rotation (potatoes, oats or barley, sugar beets), and (3) 6-year rotation (3 years of alfalfa, potatoes, oats or barley, sugar beets). Neither manure nor fertilizer was added to these plots during the 39 years of the experiment.

The soil from the surface 2 inches of the potato plots was sampled and separated into 13 size fractions by means of rotary sieves. The resistance of aggregates in each size fraction to dispersion in water was obtained by shaking the aggregates in water for 2 and 2,000 minutes. The size of distribution of aggregates in water was determined by means of sieves, elutriators, gravity, and centrifugal sedimentation. The degree of aggregation of soil particles is expressed by the ratio:

$$\frac{\text{Geometric mean diameter of aggregates}}{\text{Geometric mean diameter of ultimate particles}}$$

The size distribution of aggregates in water prior to any dispersion treatment is taken as that obtained by dry-aggregate analysis, provided the aggregates are wetted either under partial vacuum or by capillarity. The ratios of geometric mean diameter for aggregates in water prior to shaking were 16, 10, and 31 for the continuous cropping, 3-year rotation, and 6-year rotation, respectively. Shaking the aggregates in water for 2 minutes produced a marked decrease in the ratios for the 3 plots: 1.79, 1.97, and 3.21. The marked decrease in the ratios in the 2-minute shaking period indicates the instability of large diameter aggregates in water. The plot with alfalfa in the rotation showed a pronounced effect on the aggregation of soil particles as compared to the plots without alfalfa. Even after 2,000 minutes of shaking the aggregates in water, the plot with alfalfa showed a high degree of aggregation of soil particles. Highly significant regression coefficients were obtained with aggregation and clay content or total nitrogen content or apparent density of air-dried aggregate or 15-atmosphere tension values.

OBSERVATIONS ON FACTORS INFLUENCING THE EVAPORATION OF SOIL MOISTURE

By J. C. Hide. Soil Sci. Soc. Amer. Proc. 18: 234-239. 1954.

Important variables which influence the rate of evaporation of soil moisture are (1) the vapor-pressure difference between the layer from which water is evaporating and that of the turbulent atmosphere and (2) intervening layer's resistance to vapor flow. The vapor-pressure difference is associated with the temperature of the

layer from which evaporation is taking place and the temperature and relative humidity (vapor pressure) of the turbulent air. While capillarity moves water fast enough to keep the surface moist, the principal resistance to vapor flow is caused by the thin layer of nonturbulent air adjacent to the surface. Resistance increases rapidly as the surface dries so that water vapor moves through a thickening layer of dry soil.

Adsorption of moisture by the dry layer and re-evaporation associated with the diurnal temperature cycle complicate the process. Moisture movement in the upper layers of soil during the evaporation cycle was studied by periodic weighing of soil in vertically stacked porous bottomed containers and through the use of tensiometers. The data show the highly dynamic nature of the moisture regime in the surface layers of soil associated with diurnal temperature changes and the evaporation cycle.

SOIL MOISTURE STUDIES OF SOME GREAT PLAINS SOILS I. FIELD CAPACITY AND "MINIMUM POINT" AS RELATED TO THE MOISTURE EQUIVALENT

By J. S. Cole and O. R. Mathews. Soil Sci. Soc. Amer. Proc. 18: 247-252. 1954.

Field determinations of soil moisture were made on land either continuously cropped to wheat or alternately fallowed and cropped to wheat, to depths up to 6 feet for periods up to 30 years at 31 stations or locations in the Great Plains. These determinations were made at intervals throughout the period of seedbed preparation and the life of the crop. Two of the major points of interest that developed were the quantity of water the soil could continue to hold against the pull of gravity, and the portion that could not be used by the wheat crop. Late in the 1930's data on these two points were abstracted on all plots--121--where enough data were available to make the abstractions reliable. The moisture equivalent was used as an expression of texture in examining these data. The results were assembled but not published. Recently these field-determined values have been compared with laboratory values obtained through recently developed techniques (Part II of this paper.) Their relation to the moisture equivalent is presented partly as background for these other studies.

The moisture equivalent had a good but not an exact relation to the field capacity throughout the range of soils studied. The regression lines established showed that there was a slight reduction in field capacity with depth, probably due to the manner of wetting.

THE EFFECT OF RATE OF WETTING ON WATER UPTAKE AND COHESION OF SOIL CRUMBS

By W. W. Emmerson and G. M. F. Grundy. Jour. Agr. Sci. 44: 249-253. 1954.

Short columns of air-dry soil crumbs were wetted at different rates and, after draining to a standard suction, the amount of water taken up by each column determined. It was found that this increased continuously with rate of water application. The corresponding progressive decrease in the cohesion of the wetted crumbs has been measured by their resistance to break down under the impact of falling water drops. By developing this into a rapid and sensitive method, it has been shown that the loss of cohesion is due almost entirely to entrapped air, nonuniform swelling of the clay being a negligible factor in weakening crumbs.

The aggregates investigated were taken from adjacent fields differing only in their cropping treatment; one being continuous arable and the other under continuous grass. The extrapolated value of the cohesion of the grassland crumbs at zero rate of wetting was twice that of the arable, indicating an additional cohesive force in the grassland crumbs. The cohesion of the arable soil fell much more rapidly with increased rate of wetting than that of the grassland, probably because the roots in the grassland crumbs provide easy escape passages for the air.

EFFECT OF ROOT GROWTH AND DECAY ON THE PERMEABILITY OF A SYNTHETIC SANDY LOAM

By K. P. Barley. Soil Sci. 78: 205-210. 1954.

The growth of corn roots through a column of synthetic sandy loam, under either sterile or nonsterile conditions, compacted the soil between the root channels and greatly reduced the permeability

of the column. When the roots decayed, the freeing of their channels for water movement caused an increase in permeability.

SOME FACTORS AFFECTING RATES OF IRRIGATION WATER ENTRY INTO RAMONA SANDY LOAM SOIL

By A. F. Pillsbury and S. J. Richards. Soil Sci. 78: 211-217. 1954.

The ammonium sulfate, organic matter added treatment was more erratic in its effects on infiltration rates than were the other treatments. This may be due to variability in the amounts of organic matter accumulated on the soil surface. In moderate applications, ammonium sulfate resulted in significantly higher infiltration rates than did urea when in combination with large amounts of organic matter, but exhibited no significant superiority when combined with small amounts of organic matter.

The information here concerns the effects of various weed-control practices in citrus groves and a comparison of urea with ammonium sulfate on the rates of water entry into the soil.

A RAPID METHOD FOR CALIBRATING SOIL MOISTURE ELEMENTS OF THE POROUS BLOCK TYPE

By R. L. Closs. Soil Sci. 78: 333-338. 1954.

A rapid method for calibrating gypsum block soil-moisture elements is described. The method, which is independent of soil type, is based on the relation between the pF and the freezing point of the water in the pores of the element. Thermocouples embedded in the gypsum have been found to be satisfactory for measuring the small depressions in the freezing point. The calibration is completed in about 3 days, and several elements can be calibrated in this period.

NEW TYPE ELECTRODE FOR PLASTER OF PARIS MOISTURE BLOCKS

By G. J. Bouyoucos. Soil Sci. 78: 339-342. 1954.

A new type electrode adopted for plaster of paris soil-moisture blocks consists of stainless steel 20-mesh screen 15/16 inch

long, 4/16 inch wide and placed vertically 3/16 inch apart.

This screen-type electrode constitutes a very important improvement in the blocks. The plaster becomes enmeshed in the screen to produce a reinforced multiple contact between the electrode and the casting, which ensures more stable performance than that of the original blocks, which were made with straight wire electrodes. The new blocks become sensitive to change in soil-moisture content at a tension ranging from about 260 to 330 cm. of water. The new plaster of paris blocks with the screen-type electrode begin to measure soil moisture, therefore, at about field capacity.

EFFECT OF VARIOUS EXCHANGEABLE CATION RATIOS IN SOILS ON GROWTH AND CHEMICAL COMPOSITION OF AVOCADO SEEDLINGS

By J. P. Martin and F. T. Bingham. Soil Sci. 78: 349-360. 1954.

Results of a study to determine the effects of various exchangeable K, Na, H, Ca ratios and of excess $CaCO_3$ on growth and chemical composition of avocado seedlings are reported. Seedling growth was not significantly different in soils ranging from 55-percent exchangeable H(pH 4), through base saturated soil, to soil containing 2-percent excess lime.

Avocado seedlings were injured and growth reduced by Na and K percentages which are not sufficiently high to affect many other plants and which have been considered relatively low. In soil with an exchange capacity of approximately 19 me./100 g., Topa Topa seedlings were slightly injured by 13-percent K and severely injured by 25 percent. Twelve-percent exchangeable K reduced growth of Mexicola seedlings, and 23 percent caused leaf burn. Approximately 3- to 4-percent K in the leaves was associated with K leaf-burn patterns.

RESPONSE OF TUNG TREES TO PHOSPHORUS AND OTHER ELEMENTS ON SAVANNAH VERY FINE SANDY LOAM

By M. Drosdoff, W. W. Kilby, and G. F. Potter. Soil Sci. 78: 361-366. 1954.

Trees of five tung clones planted in 1941 on Savannah very fine sandy loam,

were supplied with low and high levels of phosphorus, potassium, calcium, and magnesium in factorial combination from planting through 1949. The phosphorus treatment was outstanding in increasing yields, and the high yields were associated with large increases in leaf phosphorus. Added phosphorus also increased the leaf content of nitrogen, calcium, and magnesium but by 1949 had reduced the leaf potassium because of the increased production of tung fruit, which caused a drain on the potassium supply. The five clones differed somewhat in their responses to phosphorus. Clone F-541 showed the greatest proportionate increase in yield and L-9 the greatest absolute increase.

INFLUENCE OF THE POLYELECTROLYTE CRD-186 ON AGGREGATION AND OTHER PHYSICAL PROPERTIES OF SOME CALIFORNIA AND ISRAELI SOILS AND SOME CLAY MINERALS

By J. Hagin and G. B. Bodman. *Soil Sci.* 78: 367-378. 1954.

Additions of the polyelectrolyte soil conditioner CRD-186 to a number of California and Israeli soils appreciably increased the sizes and percentages of water-stable aggregates. Drying of the treated soils was unnecessary to produce the effect of the polyelectrolyte.

When subjected to pressures of less than 1 atmosphere, soils treated with CRD-186 retained less water than did untreated soils at the same pressures; under higher pressures, such differences were not observed. The results of these measurements are in accord with those found in water-stable aggregate analyses.

Treatment with CRD-186 did not appreciably change the interplanar spacings of treated soil colloids and clay minerals, as revealed by X-ray analyses. But the treated colloids and clay minerals produced clearer and stronger lines. Experiments with sand and clay-mineral mixtures showed that the reaction between CRD-186 and mineral particles is a surface reaction, and for a given surface area a definite amount of CRD-186 is needed to produce full aggregation. It is concluded that coorientation of mineral particles and polymer molecules takes place as a result of reaction between polymer and external surface of the clay-mineral particles, which results in their water-stable aggregation.

MOVEMENT OF MOISTURE IN UNSATURATED SOILS

By W. J. Staple and J. J. Lehane. *Canad. Jour. Agri. Sci.* 34: 329-341. 1954.

Samples taken at different time intervals during the redistribution of moisture in cylinders of soil were used to determine liquid and vapor movement. Mean capillary conductivities were presented for Wood Mountain clay loam with apparent specific gravities 1.21, 1.28, and 1.33, and moisture contents 12 to 27 percent. By converting conductivity to diffusivity, viz., to percent moisture conducted into a 1-inch section of soil per day under a gradient of 1-percent moisture per section, coefficients for liquid and vapor movement were plotted as a continuous function of moisture content. Movement in the vapor phase was a little lower than that calculated from vapor-pressure data. The results were used to illustrate a numerical method for calculating soil-moisture movement.

Soil Chemistry

CHEMICAL CHARACTERISTICS OF CERTAIN PROFILES OF ALLUVIAL SOILS IN THE LOWER MISSISSIPPI FLOOD PLAIN

By B. N. Driskell. *Soil Sci. Soc. Amer. Proc.* 18: 140-142. 1954.

The soils of the lower Mississippi flood plain are derived from the Mississippi or Red River depositions. In certain areas these have been mixed. The soil constituents have been modified or changed entirely by time and environment.

Profiles from the Iberia, Buxin, and Baldwin soil series were studied. The comparative results indicate that the Iberia was highest in exchangeable calcium and base saturation. Exchangeable magnesium and potassium were highest in the Buxin. Baldwin was lowest in total cation exchange.

The Buxin series contained larger quantities of the oxides of iron, aluminum, magnesium, potassium, and sodium as shown by analysis of the clay fraction than Iberia or Baldwin. Iberia was highest in calcium oxide and Baldwin highest in silica. The content of silica increased with depth for all profiles.

A COMPARISON OF THE EFFECTS OF EXCHANGEABLE SODIUM AND POTASSIUM UPON THE PHYSICAL CONDITION OF SOILS

By R. C. Reeve, C. A. Bower, R. H. Brooks, and F. B. Gschwend. *Soil Sci. Soc. Amer. Proc.* 18: 130-132. 1954.

The effects of exchangeable sodium and of exchangeable potassium upon soil physical condition were compared by means of permeability ratio, air to water, and modulus of rupture determinations. The permeability ratio is a measure of the change in pore-size distribution due to the action of water, and the modulus of rupture is a measure of soil crusting. The permeability ratio and modulus of rupture increased markedly with increasing exchangeable-sodium-percentage, whereas, increases in the exchangeable-potassium-percentage had little effect.

The relation of the permeability ratio to exchangeable-sodium-percentage can be expressed by an exponential equation of the form, $y = ae^{bx}$, whereas, the modulus of rupture is linearly related to exchangeable-sodium-percentage by the equation $y' = mx + c$. The parameters a , b , m , and c of the respective equations are positively correlated with cation-exchange capacity and total specific surface.

CATIONIC ACTIVITIES AS INDEXES FOR CHARACTERIZING FIVE ARKANSAS SOILS OCCURRING IN THE SOUTHERN REGION

By E. O. McLean and F. E. Baker. *Soil Sci. Soc. Amer. Proc.* 18: 143-147. 1954.

Five soils and three extracted colloidal materials were characterized by means of the clay membrane electrode technique for measuring ionic interactions. The study dealt with Lakeland loamy fine sand, Ruston sandy loam, Crowley silt loam, Houston clay, Sharkey clay soils and the $< .2 \mu$ clay, the $< 25 \mu$ clay, and the crude humic acid fractions extracted from the Sharkey clay soil.

The results indicate kaolinite clay dominates the regulation of cationic interactions in the Lakeland, Ruston, and Crowley soils. Beidellite appears to predominate in the Houston and Sharkey soils. Montmorillonite seems to play a major role in the $< 25 \mu$ clay from the Sharkey, but the beidellite evidently masks the effect of the

montmorillonite in the $< .2 \mu$ clay and in the whole soil. The crude humic acid from the Sharkey gave no evidence of any appreciable effect upon the cationic interactions of the whole soil.

INFLUENCE OF FACTORIALLY COMBINED LEVELS OF CATIONS AND NITRATE IONS ADSORBED ON ION-EXCHANGE RESINS ON THE NUTRIENT ABSORPTION BY PLANTS

By H. V. Welch, Jr., A. Wallace, and R. T. Mueller. *Soil Sci. Soc. Amer. Proc.* 18: 137-140. 1954.

The interaction of different levels of cations and nitrate nitrogen adsorbed on synthetic exchange resins upon nutrient absorption by plants was studied in a pot experiment. A factorial design of three levels of cations and three of N was used. Ca, Mg, and K were supplied at the same ratio at all three levels, and P and S were unvaried. Three successive plantings of lemon cuttings, oats, and oats and radishes together were made. The last two species were seeded together because their roots have different cation-exchange capacities. The adsorbed ions proved to be an excellent source of nutrients for the plants.

A balance sheet was prepared for all nutrients removed by the crops. Yields were limited in the second and third crops by both N and cation levels. K proved to be the limiting cation. Ca and Mg absorption was depressed as the cation level increased because of increased K uptake. The m. e. of cations per 100 grams dry-plant weight increased with increasing cation levels for two oat crops, but was more constant for a lemon and a radish crop. Increasing N levels resulted in increased N and in an increased total anion uptake, but resulted in depressed P and S uptake. The level of adsorbed N did not appear to influence the total cation content in lemon and radish, but there was a slight effect on oats, particularly in the first crop. The level of cations did not appear to influence the N or the m. e. sum of anions in the plants beyond the differences caused by yield variations. The cation-anion ratios in the plants were much narrower than those in the nutrient medium. Increases in N tended to result in increased K and Mg contents in the lemon cuttings and in oats when the supply of cations was high. When the cation level was low for oats, and at all levels for

radishes, increases in N tended to result in decreased K. The latter effect was partly related to K depletion at the low cation levels combined with yield increases due to N.

PLANT AND SOIL STUDIES WITH RADIO-ACTIVE MANGANESE

By E. M. Romney and S. J. Toth. *Soil Sci.* 77: 107-117. 1954.

An experiment was carried out in the greenhouse to observe, by means of autoradiographs and radio assays, the absorption and distribution of Mn54 in various plants, to study the effect of different levels of Co and Fe on the Mn54 uptake by soybeans, and to determine the fate of Mn when applied to virgin Norton and Sassafras soils in the form of MnSO₄ tagged with Mn54. Mature leaves of buckwheat, soybean, and sunflower plants accumulated more Mn54 than did young leaves. Stems of all plants contained less Mn54 than did the leaves.

Autoradiographs showed Mn54 concentrated in the tips of alfalfa leaves and in marginal and interveinal tissue of soybean and tomato leaves. Numerous small "islands" of Mn54 occurred in the interveinal tissue of mature soybean and tomato leaves.

When painted on foliage, Mn54 was absorbed through leaf, petiole, and stem tissue and translocated throughout the plant, the tendency being for more of the foliage-absorbed Mn54 to move upward than downward from the point of application to regions of actual growth. An increase in the amount of available Co in a nutrient solution significantly reduced the amount of Mn54 taken up by soybeans.

CHEMICAL AND MINERALOGICAL PROPERTIES OF A BROWN PODZOLIC SOIL

By T. Tamura and C. L. W. Swanson. *Soil Sci. Soc. Amer. Proc.* 18: 148-153. 1954.

Chemical and mineralogical studies were made of the Wethersfield silt loam, a brown Podzolic soil derived principally from sandstone, siltstone, and shale. The clay minerals identified were illite, vermiculite, chlorite, and interstratified montmorillonite-chlorite. Illite decreased from the parent material (70 percent) to

the surface (35 percent) while vermiculite increased from 5 percent in the parent material to 40 percent in the surface. The interstratified montmorillonite-chlorite was positively identified in the B₃ and C horizons and composed 15 percent of the clay fraction. The chlorite, hematite, quartz, and feldspars were present in quantities ranging from 5-10 percent each. Field observations of a compact C horizon capable of supporting a perched water table and a 7-percent slope facilitating lateral movement of water help to explain the results of the mechanical, chemical, and mineralogical analyses performed in the laboratory.

REACTION OF PHOSPHATE WITH KAOLINITE IN DILUTE SOLUTION

By G. C. Russell and P. F. Low. *Soil Sci. Soc. Amer. Proc.* 18: 22-25. 1954.

A typical adsorption curve obeying the Freundlich equation was produced by the adsorption of phosphate on kaolinite. By saturating the exchange complex of the clay with aluminum ions, phosphate adsorption was markedly increased indicating that exchangeable aluminum will react with the added phosphate.

Reflectance-wave length curves of aluminum-treated kaolinite revealed the presence of aluminum ions or hydrous aluminum oxide films on the surface of natural kaolinite. This reactive aluminum was reduced by extraction of the clay with aluminum-complexing reagents. The adsorption of phosphate was also reduced by the same treatment. Phosphate adsorption was further reduced by the presence of an aluminum complexing reagent in the phosphate solution reacting with the extracted clay. It was concluded that adsorbed aluminum precipitates the phosphate as an aluminum phosphate on the kaolinite surface.

CORRELATION OF SUGAR BEET YIELDS WITH CHEMICAL PROPERTIES OF A SALINE-ALKALI SOIL

By C. A. Bower, C. D. Moodie, P. Orth, and F. B. Gschwend. *Soil Sci.* 77: 443-451. 1954.

The yields of sugar beets from 64 plots of Umapine fine sandy loam variably affected by salinity and alkali were correlated with various chemical properties of

the 0-12-inch soil layer. The chemical properties consisted of electrical conductivity, soluble-calcium-percentage and logarithm of the sodium-adsorption-ratio of the saturation extract, exchangeable sodium content, exchangeable potassium content, and pH of saturated soil. Simple linear correlation analyses showed all the soil properties except exchangeable potassium content were significantly correlated with yield, the coefficients of determination (r^2) ranging from 47.1 to 82.4 percent. Since there was a marked degree of intercorrelation among several of the soil properties, the data were subjected to multiple linear correlation analysis.

The coefficient of multiple determination (R^2) between yield and the determined soil properties, excluding exchangeable potassium content, was found to be 84.9 percent. Calculation of "beta" coefficients showed exchangeable sodium content had a major effect and the soluble-calcium-percentage a moderate effect upon the multiple correlation. The effects of other properties in determining the multiple correlation were not significant.

LOSS OF NITROGEN THROUGH REACTION OF AMMONIUM AND NITRITE IONS

By A. Wahhab and F. Uddin. Soil Sci. 78: 119-126. 1954.

Loss of nitrogen due to interaction of NH_4 and NO_2 ions was studied both in aqueous media and in alkaline soils. In low concentrations, the two ions did not interact; at higher concentrations, elemental nitrogen was lost only after desiccation, which increased the concentration of the two ions. The interaction depends mainly on the concentration of the reactants. It is independent of soil as a substrate and of the temperatures of desiccation. When the pH values were slightly on the alkaline side, losses of nitrogen through volatilization of NH_3 and spontaneous decomposition of NaNO_2 from soils on desiccation were much higher than those which could occur through interaction of the ions. In highly alkaline soil, however, the loss in $\text{NO}_2\text{-N}$ due to interaction is very high.

MULTIPLE REGRESSION ANALYSIS OF SOIL DATA

By C. H. Wadleigh and M. Fireman. Soil Sci. 78: 127-139. 1954.

This statistical study is presented to show how multiple regression analysis may be used to evaluate soils data involving several concomitant variables. In the cases presented, it could not be determined by ordinary inspection of the data whether the measurements taken adequately delineated or characterized the problem soils with regard to the variable being studied, nor was it possible properly to evaluate the various factors being studied.

By means of multiple regression analysis, exchangeable-sodium-percentage, saturation percentage, pH and settling volume were evaluated to determine in the laboratory their effect on permeability. Also, it was determined which of the measurements might safely be neglected in future studies of soils from each area. More important, however, is that in the soils from the Tucumcari area, 88 percent of the variance was accounted for by the measurements taken, and so these measurements adequately characterized these problem soils, whereas the identical measurements accounted for only 53 percent of the variance in the soil samples from the Emmett Valley area. The latter problem soils, therefore, were not adequately characterized by the four measurements taken, a fact not evident from casual inspection of the data. The statistics indicated that additional research would be necessary to find other laboratory measurements related significantly with laboratory permeability. This study further indicated that multiple regression analysis may be useful in evaluating whether the important factors characterizing problem soils have been adequately explored.

PHOSPHORUS DIFFUSION IN SOILS

By D. R. Bouldin and C. A. Black. Soil Sci. Soc. Amer. Proc. 18: 255-259. 1954.

The validity of activity measurements as estimate of phosphorus diffusion from

P³² tagged phosphate sources was investigated. Significant changes in the apparent specific activity of diffusing phosphorus were found; these could be accounted for by assuming exchange between diffusing P³² and native soil P³². Despite such changes in apparent specific activity, the overall picture of phosphorus diffusion obtained from activity measurements was not substantially different from that obtained by total phosphorus analysis. One-dimensional diffusion of tagged phosphates from Ca(H₂PO₄)₂ and KH₂PO₄ sources was studied in 10 water-saturated soils using X-ray film and Geiger tubes to estimate the resulting distribution of diffused phosphorus. The X-ray film revealed many local areas of P³² concentrations 0.5 to 2 mm. in diameter. Large-scale irregularities in the curves relating phosphorus concentration in the soil column to distance from the source were found in three cases.

In both Miami silt loam and Muscatine silt loam with Ca(H₂PO₄)₂ as source, peaks of phosphorus concentration were found at 4-cm. intervals. With Miami silt loam and KH₂PO₄ as source, one peak of phosphorus concentration was found about 1 cm. from the source. Distribution of diffused calcium, as measured by extraction with 0.5N acetic acid was similar to distribution of diffused phosphorus in Muscatine and Miami silt loam columns treated with Ca(H₂PO₄)₂.

SOME FACTORS AFFECTING THE ADSORPTION OF SULFATE BY ALABAMA SOILS

By L. E. Ensminger. Soil Sci. Soc. Amer. Proc. 18: 259-264. 1954.

The sulfate content of a number of Alabama soils was determined by extracting with various solutions. The sulfate extracted was measured turbidimetrically. Some factors affecting the adsorption of sulfate by soils were studied. About the same amount of sulfate was extracted by neutral sodium acetate solution, sodium acetate buffered at pH 4.8, KH₂PO₄ solution containing 100 ppm. phosphorus, and KH₂PO₄ solution containing 500 ppm. phosphorus. However 0.1 N HCl solution extracted little or no sulfate except where sulfate had been recently applied. The results show that sulfate is retained to a certain extent by most soils. The subsurface layers usually contain more sulfate and are capable of adsorbing more sulfate

than the surface layers. The surface layers of most of the light-textured soils did not contain sulfate or show a capacity to adsorb sulfate from solution.

A CLAY MINERALOGICAL STUDY OF CERTAIN REDDISH PRAIRIE SOILS OF OKLAHOMA, WITH AN ESTIMATION OF THE MONTMORILLONITE AND ILLITE CONTENT

By G. E. Wilkinson and F. Gray. Soil Sci. Soc. Amer. Proc. 18: 264-268. 1954.

The clay fraction of the B and C horizons of a Dennis soil (from Pennsylvanian silty and clayey shale deposits) were analyzed for the percentages of montmorillonite and illite.

In the analysis, the clay-size material of the soil was separated into three fractions. Ethylene glycol retention, nonexchangeable potassium, and cation exchange-capacity determinations were made on each fraction. Percentages of montmorillonite and illite were computed.

The clay mineral contents of the Dennis and Kirkland soils were similar, with 35- to 50-percent montmorillonite and 20- to 25-percent illite in the B horizons and 40- to 50-percent montmorillonite and 20- to 35-percent illite in the C horizons.

The fractionation of the clay also permitted a study of the properties due to particle-size distribution. Montmorillonite was found to be the predominant clay mineral in the < 0.1 μ fractions and about equal with illite in the 0.6 to 0.1 μ fractions. Minerals other than montmorillonite and illite comprised a large portion of the 2.0 to 0.6 μ fractions.

POTASSIUM FIXATION IN DUTCH SOILS: MINERALOGICAL ANALYSES

H. W. van der Marel. Soil Sci. 78: 163-179. 1954.

Potassium fixation, the phenomenon by which K ions are bound with such strength by the soil that they cannot be freed by cations of buffered salts of approximate neutrality, is caused in Dutch soils by a variety of illite with open lattices, which are contracted by entrance of K ions between the layers the < 2 μ separate from Dutch soils may contain up to 80 percent of this clay mineral, which has been named ammersooite, in honor of the potash experimental field at Ammersoien,

where the K-fixing phenomenon was first observed in Dutch soils. The lattices of ammersooite, which have a basal spacing of 15.6 A., are further contracted by NH_4 , Rb, and Cs ions to that of common (Fithian) illite, 10.8 A.

They are not contracted by $\text{H}^+(\text{H}_3\text{O}^+)$, Li^+ , Na^+ , Mg^{++} , Ca^{++} , Sr^{++} , and Ba^{++} , which have a smaller polarizability per valence unit. Neither are they contracted by diethyl, dimethyl, or trimethyl ammonium ions. These ions are highly polarized but are too large for the hexagonal spaces between the layers. Ammersooite may also occur in soils from Belgium, France, and Surinam having a high K-fixing capacity. The entrance of K ions into the layers may be blocked by $\text{Fe}(\text{OH})_3$, $\text{Al}(\text{OH})_3$, or difficulty exchangeable Fe^{+++} and Al^{+++} , as was found in a French soil. The blocking can be eliminated by treating the clay separate with dilute KOH or NaOH solution.

DIFFERENCES IN SODIUM AND POTASSIUM CONTENT OF VARIOUS PARTS OF THE COTTON PLANT AT FOUR STAGES OF GROWTH

By E. D. Appling and J. Giddens. Soil Sci. 78: 199-203. 1954.

Cotton was grown on Cecil soil with five treatments varying in sodium and potassium. Plants were harvested at pre-square, full-square, early boll, and full-maturity stages and fractionated into top immature leaves, lower leaves, stems, and roots. The samples were analyzed for sodium and potassium.

Where potassium was deficient in the soil, potassium accumulation was greatest in top immature leaves, and sodium accumulation was greatest in lower leaves, with intermediate amounts of both sodium and potassium in stems and roots. Where soil potassium was low, meristematic regions of the plant received most of this potassium, sodium moving into the other areas and thus probably performing part of the functions of potassium. In the check treatment, the topsoil having had 48 pounds of native exchangeable K_2O per acre, there was not sufficient potassium to supply the needs of the plant. Application of 24 pounds of K_2O as muriate in the presence of NaCl chemically equivalent to 48 pounds of K_2O , seemed to meet the potassium requirements of cotton on this soil.

THE EFFECT OF 2, 4-DICHLOROPHENOXYACETIC ACID ON THE HYDROCYANIC ACID AND NITRATE CONTENT OF SUDAN GRASS

By C. R. Swanson and W. C. Shaw. Agron. Jour. 46: 418-421. 1954.

The effects of several rates of 2, 4-D applied at several stages of growth under greenhouse and field conditions on the hydrogen cyanide and nitrate content of Sudan grass were investigated. Under greenhouse conditions 2, 4-D depressed the HCN content of Sudan grass for the one sampling date employed. In the field the HCN content of treated Sudan grass was initially depressed but rose rapidly 4 days after treatment to levels significantly higher than the controls for the rest of the experiment.

Application of 2, 4-D to Sudan grass in the field resulted in a brief increase in nitrates followed by a rapid decrease to levels below the controls. At the end of a month after treatment, nitrate content of treated plants was equal to or greater than the controls. A possible interrelation between nitrate and cyanogenetic glucoside metabolism as affected by 2, 4-D is discussed.

COBALT ADSORPTION AND RELEASE IN CATION-EXCHANGE SYSTEMS

By W. F. Spencer and J. E. Giesecking. Soil Sci. 78: 267-276. 1954.

Cationic exchange reactions of cobalt were studied with cobalt adsorbed on Amberlite IR-100, Wyoming bentonite, and Swygart clay. The results indicate that cobalt is adsorbed on the exchangers more strongly than is calcium. Accordingly, the exchangeability of soil-adsorbed cobalt in field soils--hence, the proportion of cobalt available to plants--should decrease as the amount of adsorbed cobalt becomes less.

The relative amounts of cobalt adsorbed, calcium released, and H ions formed in the reactions indicate that Co^{++} is adsorbed on the exchangers as the monovalent hydroxy-cobaltous ion and as the divalent cobaltous ion. The H-ion concentration of the reaction medium presumably determines which ion predominates on the exchanger.

SOIL AND PLANT STUDIES WITH CHELATES OF ETHYLENEDIAMINETETRAACETIC ACID

By H. F. Perkins and E. R. Purvis. Soil Sci. 78: 325-330. 1954.

Experiments were conducted to determine effects of Na_2EDTA and Mn-EDTA in soils and plants. A study was also made of the absorption and metabolism of EDTA by plants. The more important findings were:

Heavy applications of Na_2EDTA to soils resulted in greater increase of extractable Fe than of extractable Mn, Ca, Mg, or K. In general, the order of release of cations followed the order of stability of the chelates in solution. Easily reducible Mn was increased slightly as a result of the treatment. Available P was increased only at the 5,000-pound-an-acre treatment. Soil pH values were not influenced. Applications of MnEDTA at a rate of 4.2 pounds Mn an acre to soil subjected to six wetting-and-drying periods resulted in a marked increase in water-soluble and exchangeable Fe and a marked decrease in water-soluble and exchangeable Mn. The ratio of Fe to Mn was increased from 1 to 26. Easily reducible Mn was inversely proportional to exchangeable Mn.

Soil Biology

THE INFLUENCE OF SOIL AGGREGATE STABILIZERS ON THE BIOLOGICAL ACTIVITY OF SOILS

By W. H. Fuller and C. Gairaud. Soil Sci. Soc. Amer. Proc. 18: 35-40. 1954.

The influence of three synthetic electrolytes, hydrolyzed polyacrylonitrile (HPAN), modified vinyl acetate maleic acid compound (VAMA), and a new polymer 212 on the biological activity in six agricultural Arizona soils and quartz sand was investigated. Particular attention was directed to (1) the rate and extent that these materials decompose, (2) the possible toxic or inhibitory effect that these materials may exert on the soil microflora, and (3) the effect that these materials have on the rate and extent of decomposition of a crop residue such as oat straw.

VAMA was found to stimulate biological activity in soil as evidenced by the total cumulative CO_2 evolved during 14 days of incubation with soil. HPAN and polymer

212 had little effect on the overall biological activity of well-aerated soil cultures during this incubation. This situation appeared to be the same regardless of the presence or absence of oat straw.

PROTEIN-MONTMORILLONITE COMPLEXES, THEIR PREPARATION AND THE EFFECTS OF SOIL MICROORGANISMS ON THEIR DECOMPOSITION

By L. A. Pinck, R. S. Dyal, and F. E. Allison. Soil Sci. 78: 109-118. 1954.

Protein-montmorillonite complexes were prepared by three methods, and their rates of decomposition by soil microorganisms in sand and soil determined. These studies were supplemented by X-ray diffraction data on the complexes before and after subjection to biological attack.

In complexes containing about 10-percent protein and having a c-spacing of near 15 Å., most of the protein was present as a monolayer between the crystal lattice sheets. Only about 20 percent of the protein was decomposed in 4 weeks, which corresponds to about the amount that is likely to be adsorbed on the exterior surface. Apparently proteolytic enzymes are not able to penetrate between the layers of montmorillonite in such preparations. Where two or more layers of proteins were present, however, this protein decomposed to about the same extent as where protein alone was added to sand. X-ray studies indicated strongly that during decomposition of such complexes new monolayer complexes of montmorillonite and protein, or protein degradation products were formed. These residual complexes had an observed c-spacing of about 12.7 Å., indicating that only about half of the spaces between the montmorillonite layers were filled.

NUTRITIONAL GROUPS OF SOIL BACTERIA ON THE ROOTS OF BARLEY AND OATS

By R. H. Wallace and H. deL. King. Soil Sci. Soc. Amer. Proc. 18: 282-285. 1954.

Barley and oats were grown each in 5 replicate field plots. At 2 stages of growth, namely the "tiller" and "head" stages, plants were removed and bacteria were isolated from composite samples of soil that adhered to the roots. Bacteria were also isolated from the soil between

the rows of plants. The bacteria were then arranged into 7 groups according to their growth in a variety of nutritional media; it was found generally that those requiring yeast occurred with the greatest frequency. The results were analyzed statistically and it was found that specific "rhizosphere effects" existed chiefly in relation to the age of the plants, and that those effects occurred more frequently with regard to barley than with oats. Root excretions in the rhizosphere soils of barley and oats had little or no effect on the equilibrium of the nutritional groups. Emphasis is placed on the importance of replicating samples and analyzing results statistically.

A CHEMICAL-MICROBIOLOGICAL STUDY OF EFFECTS OF EXCHANGEABLE CATIONS IN SOIL AGGREGATES

By D. G. Aldrich and J. P. Martin. Soil Sci. Soc. Amer. Proc. 18: 276-283. 1954.

Data were obtained in a study of the effect of various exchangeable cations on soil aggregation and microorganisms. Twenty-one treatments of various combinations and ratios of exchangeable Ca, Mg, Na, K, and H were compounded by appropriate treatment of a Hanford sandy loam and a Yolo sandy loam. The soil samples of varying cation composition were incubated alone and in combination with organic-matter sources of high and low carbon-nitrogen ratio for a period of 200 days. Soil aggregation measurements and counts of kind and number of soil microorganisms were made at various intervals during incubation. In comparison with a calcium system, the following results were noted: (1) A high percentage of Mg has no effect on aggregation; (2) depending on the soil, a high percentage of exchangeable K may or may not reduce aggregation; (3) increasing Na reduces aggregation; (4) an excess of free lime reduces aggregation; (5) kinds and numbers of microorganisms are affected more by organic-matter additions than by cation composition of soil; and (6) organic-matter additions increase aggregation regardless of cation composition.

MYCORRHIZAL FUNGI: THEIR DISTRIBUTION AND EFFECT ON TREE GROWTH

By S. A. Wilde. Soil Sci. 78: 23-29. 1954.

Soils of chernozem, prairie, and marsh origin do not provide conditions suitable for normal development of trees whose root systems escaped inoculation with symbiotic organisms inhabiting forest soils. If there are trees that can grow on grassland soils in absence of fungus symbionts, Wisconsin studies failed to detect them. The microbiological deficiency of grassland soils served as the keynote to nearly all findings of the author and his research associates.

The growth of tree seedlings raised from sterilized seed serves as a reliable criterion for separation of forest and grassland soils. The normal growth of trees on grassland soils, in turn, verifies the presence of rhizospheric symbiosis.

STUDIES ON ANTIBIOTIC SOIL ORGANISMS. II. BACTERIA AND FUNGI ANTAGONISTIC TO PYTHIUM ARRHENOMANES IN SUGARCANE SOILS OF LOUISIANA

By H. H. Luke and T. D. Connell. Phytopathology 44: 377-379. 1954.

The results of a survey of fungi and bacteria in sugarcane soils of Louisiana, in regard to the antagonistic activity exhibited by these organisms toward Pythium arrhenomanes, the causal agent of sugarcane root rot are reported. Approximately 5,500 bacterial isolates and 5,000 fungal isolates were tested in artificial culture for antagonism to the root-rot fungus. About 3.6 percent of the bacteria and 16.0 percent of the fungi tested exhibited antibiotic activity toward the parasite in respect to the zones of inhibition produced, fungi were more inhibitory than were bacteria. Size of bacterial and fungal populations was affected by soil reaction, the largest bacterial population being from soils with pH values above 7.6 whereas the largest fungal populations occurred in soils with an acid reaction. The highest fungal antibiotic activity was from soils

where root rot was most severe whereas the antibiotic activity exhibited by bacteria was considerably higher in soils where root rot was not severe.

SOIL PRODUCED ANTIBIOTICS--PLANT DISEASE AND INSECT CONTROL

By J. H. Stallings. Bacteriological Reviews. 18: 131-146. 1954.

It appears that those genetic factors which impart disease or insect resistance to a plant may do so by enabling that plant to produce a more favorable microflora in the rhizosphere (the area immediately adjacent to the plant root). The modified microflora of the rhizosphere of resistant varieties may be capable of producing antibiotics which destroy or inhibit the disease-producing germs, the invading viruses, or the attacking insect pests.

The soil-borne pathogens are destroyed by the antibiotics before they make contact with the roots. Disease germs, viruses, and insects attacking the aerial parts of the plants are destroyed by antibiotics absorbed by the roots and translocated to all parts of the plant in the sap and act systemically.

Soil Genesis, Formation, Classification, and Mapping

PROFILE STUDIES OF NORMAL SOILS OF NEW YORK: IV. MINERALOGICAL PROPERTIES OF THE GRAY-BROWN PODZOLIC--BROWN PODZOLIC SOIL SEQUENCE

By S. B. McCaleb. Soil Sci. 77: 319-333. 1954.

The mineralogical properties of six profiles representing a soil sequence derived from parent materials of decreasing CaCO_3 are presented. The dominant clay mineral was illite. The most alkaline profile also contained vermiculite and montmorillonite. The most acid profiles contained some kaolinite. Photographic observations are given as evidence of the physical movement of clays from the surface horizons to form textural B horizons. Surface tension forces are suggested as the possible mechanism for the characteristic of clays in oriented positions.

SIGNIFICANCE OF SAND AND GRAVEL IN THE CLASSIFICATION, MAPPING, AND MANAGEMENT OF SOME COARSE-TEXTURED SOILS

By C. L. W. Swanson and A. Ritchie, Jr. Conn. Agr. Expt. Sta. Bul. 580. 1954.

Field and laboratory studies were made of the Hinckley and Merrimac series occurring in Hartford County, Conn., relative to their genesis, morphology, physical properties, classification, and use. Samples were taken at 6-inch depth intervals to 36 inches. A special sisene analysis was made of the entire sample (gravel $> 2'' \rightarrow 2$ mm., sand < 2 mm. > 0.25 mm.; and separates < 0.25 mm.) since these soils are high in sand and gravel. Other analyses included total porosity, bulk density and pebble count determinations.

A statistical analysis of the data for the two soils showed them to be significantly different in their content of gravel, sand (except 2-1 mm. size) and material < 0.25 mm. They were also significantly different in their total porosity and bulk density.

DISTRIBUTION OF PHOSPHORUS IN SOME GENETICALLY RELATED LOESS-DERIVED SOILS

By C. L. Godfrey and F. F. Riecken. Soil Sci. Soc. Amer. Proc. 18: 80-84. 1954.

The total and organic phosphorus were determined in five virgin-like loess-derived soil profiles occurring along a traverse in southwestern Iowa and northern Missouri. The soils studied were representative of the Prairie (Brunizem), Wiesenboden, and Planosol great soil groups. The time of soil weathering was assumed to have been the major soil formation variable affecting the soils investigated. The degree of soil profile development in southwestern Iowa had been found previously to increase in a southeasterly direction from the major source of loessial material at the Missouri River.

The data indicate a definite relation between the amount and distribution of phosphorus and a stage of soil development exhibited in each of the profiles studied.

CHANGES IN THE CRITERIA USED IN SOIL CLASSIFICATION SINCE MARBUT

By E. P. Whiteside. Soil Sci. Soc. Amer. Proc. 18: 193-195. 1954.

The changes in the criteria used in soil classification since Marbut's time are presented. These changes are of three kinds: additions to the list of properties used, refinements of the properties formerly used, and deletions from the list of properties formerly used. The additional properties now being used are mostly properties of the whole soil body. Most important among these are the properties which are independent variables of the soil system. The introduction of these independently variable properties of the soil body, for use in soil classification, presents the possibility of fusing the genetic and descriptive systems of soil classification without abandoning the premise that soils should be classified on the basis of their properties. The affect of the above changes in soil classification on the definition of the soil individual--the soil type--and its nomenclature are discussed.

THE ORIGIN OF MIMA MOUND (HOGWALLOW) MICRORELIEF IN THE FAR WESTERN STATES

By R. J. Arkley and H. C. Brown. Soil Sci. Soc. Amer. Proc. 18: 195-199. 1954.

The origin of the mound microrelief known by such names as "hogwallows," "pimple mounds" or "mima mounds" has long been a mystery; although many solutions have been proposed, none has yet received widespread acceptance.

During the course of the soil surveys of Merced and Stanislaus Counties of California, where mound microrelief is widespread, the phenomenon was studied over 8 years. All known theories were evaluated and compared with the evidence observed in the field. The evidence includes the nature of the mounds such as shape, size, internal structure, distribution of gravel, the burrows of ants and rodents, the distribution of the microrelief with respect to soil types, and the pattern of occurrence of mounds under various conditions. The evidence points clearly to a biological explanation and that the pocket gopher is responsible for mima-mound microrelief.

PROPERTIES OF THE GALVA AND MOODY SERIES OF NORTHWESTERN IOWA

By H. D. Foth and F. F. Riecken. Soil Sci. Soc. Amer. Proc. 18: 207-211. 1954.

The purpose of this investigation was to study soil development in relation to loess thickness and annual precipitation in northwestern Iowa. From a study of six profiles located along two traverses, it was concluded that soil properties were related to both loess thickness and annual precipitation on the basis of the amount and distribution of clay, percentage of total nitrogen, base saturation, and depth to secondary lime.

CLAY MINERALS OF FIVE NEW YORK SOIL PROFILES.

By R. T. Martin. Soil Sci. 77: 389-399. 1954.

Differential thermal analysis, X-ray diffraction, potash content, and glycol retention on the clay fractions from horizon samples of 5 soil series taken throughout New York State are reported. It is concluded that (1) illite, present in all samples varied from 50 to 85 percent; (2) chlorite occurred in the A horizon of 4 profiles; (3) hydrous iron and aluminum oxides were present in many samples; and their presence further complicated interpretation of the data. Variations in illite content and the occurrence of chlorites are discussed with regard to genesis of the solum of the profiles studied.

THE REGUR SOILS OF INDIA AND THEIR UTILIZATION

By R. W. Simonson. Soil Sci. Soc. Amer. Proc. 18: 199-203. 1954.

The Regur or Black Cotton soils of India seem to be members of the same great soil group as the Houston Black and Houston series of Texas, on the basis of field studies by the author in the Deccan plateau in 1951. Similarities between the soils on the separate continents are evident in morphology, contents of organic matter, clay minerals, carbonate content and distribution, and the high coefficients of expansion and contraction upon wetting

and drying. Like Houston Black clay, the Regur soils are widely used for cotton, although much greater acreages of the soils, with a total area equal to that of the Corn Belt, are devoted to sorghum, pearl millet, pulses, and other food crops.

Agricultural production is largely dependent upon animal power and human labor, with little benefit from products of heavy industry such as tractors, fertilizers, insecticides, and the like. Yield levels for most crops are low as compared to those in the United States, although yields have been stable at these low levels for centuries. Higher levels of production will require substantial changes in the agricultural arts and in the technological and industrial resources available to and used by the cultivators of the Regur soils.

THE CHARACTERISTICS OF SOME SOILS ON TILLS OF CARY AND MANKATO AGE IN MICHIGAN

By B. L. Allen and E. P. Whiteside. Soil Sci. Soc. Amer. Proc. 18: 203-206. 1954.

Field and laboratory studies were made of the well-drained soils and the associated loamy tills of the Cary and Mankato sub-stages of the Wisconsin drift in Sanilac County, Mich. The soils on the Cary till are deeper, more acid, and more clearly differentiated into horizons than those on the Mankato till. The mean carbonate content and depth of leaching of the Mankato till are 31.4 percent and 20 inches, respectively. The mean carbonate content and depth of leaching on the Cary till are 22.4 percent and 29 inches, respectively. The soil profile studied on the Mankato till is more permeable in all horizons than the profile on the Cary till. The C horizon--i.e., the glacial tills--are the most impermeable parts of both profiles.

Calculations using these data and assuming 11,000 years as the length of post-Mankato time indicate that the duration of the Cary-Mankato interglacial stage was 1,100 to 5,500 years. Further work on this point is needed.

THE MORPHOLOGY, MINERALOGY AND GENESIS OF TWO SOUTHERN NEW ENGLAND SOILS

By G. A. Bourbeau and C. L. W. Swanson. Conn. Agr. Expt. Sta. Bul. 584. 1954.

A study was made of the morphology, mineralogy, and genesis of the Merrimac

fine sandy loam and the Wethersfield silt loam, two soils occurring in the Connecticut River Valley. A special method was developed for mounting clay and silt-size minerals for analysis with an X-ray diffractometer. A special beam stop was designed to reduce background effect by stray radiation from small 2 θ angles. The mineral suites of both soils are very similar, although the Merrimac is derived from granite, gneiss, and schist from the Eastern Uplands and the Wethersfield from Triassic sedimentary rocks. This is explained by the fact that Triassic sediments of the Connecticut Valley also originated from upland rocks.

Field studies show that the glacial till of drumlins on which Wethersfield soils have developed have withstood an ice readvance. Subsequently a veneer of fresh water and/or eolian deposits was laid over and mixed superficially with the till. The Wethersfield solum has developed from this surficial admixture, and the compact substratum consists of relatively undisturbed till.

CHARACTERISTICS AND VEGETATION RELATIONSHIPS OF SOME PODZOLIC SOILS NEAR THE COAST OF NORTHERN CALIFORNIA

By R. A. Gardner and K. E. Bradshaw. Soil Sci. Soc. Amer. Proc. 18: 320-325. 1954.

A survey of vegetation and soil of wild lands in Mendocino County in northern California was completed in 1951. This survey disclosed the occurrence near the coast of some distinct podzolic soil, unique in relation to most other soils of the State, of unexpected extent, and having in part distinct vegetation associations.

This northern coastal area has cool, nearly rainless but foggy summers and mild, wet winters. Precipitation averages between 35 and 40 inches; maximum temperatures during summer average about 65° F., and minimum temperatures during winter average about 40° F.; growing season is about 285 days.

This paper deals with morphological and some chemical and physical characteristics of three soil series, the Blacklock, Noyo, and Caspar; their geographical distribution along the coast on sandy deposits, and their vegetation associations. The Blacklock, a ground-water Podzol, occurs on flat or gently sloping

surfaces and supports a unique "pygmy" forest, chiefly of Bolander pine and Mendocino cypress. The Noyo and Caspar are of questionable great-soil-group classification but both are distinctly podzolic in character, the Noyo showing a stronger degree of podzolization than the Caspar. The Noyo supports a cover chiefly of Bishop pine and the Caspar chiefly one of redwood and Douglas-fir.

Soil-plant-animal Relationships

A NUTRIENT MOBILITY CONCEPT OF SOIL-PLANT RELATIONSHIPS

By R. H. Bray. Soil Sci. 78: 9-22. 1954.

Extremes in mobility of the available forms of soil nutrients give rise to two kinds of root sorption zones for plants. One is the large volume of soil occupied by the major part of the plant's root system and is called the "root system sorption zone." The other is a relatively thin layer of soil adjacent to each root surface and is called the "root surface sorption zone."

From the root system sorption zone the roots of a plant can remove almost quantitatively the highly mobile nutrients. This results in their "net" requirement being almost equal to the crop content at maturity, that is, one amount is sufficient for only one yield of a given percentage composition. Variations in yield do not cause any marked variations in the plant's ability to secure a highly mobile nutrient. Such nutrients can act as "limiting nutrients" in the sense given in Liebig's "law of the limiting nutrient."

From the root surface sorption zones, the roots effectively obtain the relatively immobile nutrients. The sum of these small root surface sorption zones represents only a small part of the soil, hence the roots "feed on" only a small part of the relatively immobile nutrients. The amounts that must be present for maximum yields are, therefore, many times larger than the crop content. Variations in plant size (yield) can vary the plant's ability to obtain the relatively immobile nutrients. One amount is not just adequate for one yield of a given percentage composition, it can be just adequate for a wide range of yields, provided the plant's ability to obtain it is proportional to the size of the plant. When this occurs, a relatively immobile nutrient can act percentage-wise in

soil-plant relationships, that is, it can follow the Mitscherlich-Baule percentage sufficiency concept.

HYDROLOGY

General

OPEN CHANNEL FLOW OF WATER-AIR MIXTURES

By H. A. Einstein and O. Sibul. Amer. Geophys. Union Trans. 35: 235-242. 1954.

The problem is analyzed in analogy with that of sediment transport and is partially solved. While it has not been possible as yet to predict the air content of the mixture for a given state of flow or of turbulence, the vertical distribution of air in a turbulent water mass was found to follow the laws of suspension. The change of the average flow velocity and flow depth of an open-channel flow involving air-water mixtures was predicted theoretically as a function of the air concentration. The predicted relation was checked by measurements in model channels.

A SIMPLE METHOD FOR ASSESSING THE RELIABILITY OF RAINFALL

By J. Glover and P. Robinson. Jour. Agr. Sci. 43: 275-280. 1953.

A simple method to determine the expectation of selected minimum rainfall was developed on the assumption that monthly or seasonal rainfall is normally distributed over many years. Although it is realized that a perfectly normal distribution cannot be obtained, practical experience has shown that the assumption leads to no serious discrepancies and the advantage of simplicity is considerable.

A detailed example of its use to forecast the agricultural potentialities of drylands is given.

MULTIPLE TENSIOMETER FOR DETERMINING THE VERTICAL COMPONENT OF THE HYDRAULIC GRADIENT IN SOIL

By L. A. Richards. Soil Sci. Soc. Amer. Proc. 18: 7-10. 1954.

A description is given of an instrument for measuring the hydraulic head and hydraulic gradient of water in unsaturated field soil. Porous ceramic sections are

mounted between plastic spacers to make a rod-shaped instrument for insertion in a hole made by the Standard Veihmeyer soil-sampling tube. Five porous sections with a vertical spacing of 10 cm. are thus arranged with individual connections to mercury manometers mounted at the top of the assembly.

During infiltration, after 44 cm. of water had entered a deep, uniform, fine sandy loam, the downward hydraulic gradient averaged 1.3 in the 10-30-cm. depth interval. This corresponds to a downward water-moving force of 1.3 g. Six days later a few hours after a 1-cm. rain, the average downward water-moving force in the same depth interval was 5 g. Four days after the rain, there was a net upward water-moving force of 36 g. in the 10-20-cm. depth interval, due to the influence of surface evaporation. A much higher value existed in the 0-10-cm. layer because of the greater moisture gradient near the soil surface.

SAND-MODEL EXPERIMENTS ON THE DISTRIBUTION OF WATER-PRESSURE UNDER AN UNLINED CANAL

By P. R. Day and J. N. Luthin. Soil Sci. Soc. Amer. Proc. 18: 133-136. 1954.

A study has been made of the seepage of water by capillary flow (movement at pressures less than that of the atmosphere). The analysis differs markedly from previous theories of seepage which ignore capillary movement.

An idealized flow system, which consisted of parallel furrows in soil overlying a gravel substratum, was postulated in the theory and simulated experimentally in a sand model. Pressures were measured tensiometrically. The water pressure found at various points in the sand model in the steady state agreed approximately with values calculated from theory.

THE TRANSMISSION OF WATER THROUGH SNOW

By R. W. Gerdell. Amer. Geophys. Union Trans. 35: 475-485. 1954.

An instrument which makes use of the difference in the dielectric constants of ice and water was constructed and used to detect small changes in the liquid water present in a snow pack. The velocity of a moving front of water through snow and the

approximate residual storage of liquid water in the snow pack was measured by means of this instrument. Water-transmission rates were found to range from 0.9 to 24.0 inches of snow per minute. The higher rates were associated with high density snow. The residual storage of liquid water in the snow ranged between 0.7 and 5.5 percent with the majority of the measurements showing a residual storage of less than 2-percent free water or about 0.1 inch of free water per foot of snow.

PRECIPITATION MEASUREMENTS ON WIND-SWEPT SLOPES

By A. E. Helmers. Amer. Geophys. Union Trans. 35: 471-474. 1954.

Precipitation catch for 3 calendar years is compared for four types of gage installation on a wind-swept south-facing slope with a 22° gradient at elevation of 5,500 feet. The 1950 precipitation catch by (1) weighing-recording gage with the orifice and an Alter type windshield sloped parallel to the ground surface, (2) unshield nonrecording gage with orifice sloped parallel to the ground surface, (3) weighing-recording gage with horizontal orifice and Alter type windshield, and (4) unshielded U. S. Weather Bureau standard gage with funnel removed was gage (1) 62.90, gage (2) 53.34, gage (3) 39.82 and gage (4) 27.64 inches, respectively.

In 1951 the respective catches were gage (1) 61.38, gage (2) 52.94, gage (3) 35.91, and gage (4) 25.67 inches, and in 1952 they were gage (1) 39.62, gage (2) 35.01, gage (3) 27.09, and gage (4) 15.91 inches. Indications are gage (1) probably did not overestimate precipitation amounts and there is a relation between wind velocity and magnitude of differences in catch between gages.

HYDRAULIC HEAD LOSS AT THE INTERFACE BETWEEN UNIFORM SANDS OF DIFFERENT SIZES

By F. N. Leatherwood and D. F. Peterson, Jr. Amer. Geophys. Union, Trans. 35: 588-594. 1954.

The hydraulic head loss for flow occurring at an interface between sands or gravels of different sizes was studied by experiment. Dimensional analysis was

used in formulating the experiments and in analyzing the data which led to a simple relation in which the hydraulic head loss at the interface is a function of the mean diameter of the smaller-sized sand or gravel, the Reynolds number for the flow through the smaller-sized gravel, and an empirical constant which appears to depend principally on the mean-size and size-distribution characteristics of the two sizes of sand or gravel.

The action of sands or gravels used as filters were observed and confirmed the opinion of Terzaghi and others that for uniform-sized sands the ratio of the mean diameter of the filtering sand to that of the sand to be filtered must not exceed approximately five to exclude the smaller-sized material from the pores of the larger-sized material.

A METHOD FOR DETERMINING THE MINIMUM DURATION OF WATERSHED EXPERIMENTS

By J. L. Kovner and T. C. Evans. Amer. Geophys. Union Trans. 35: 608-612. 1954.

A simple graphic solution is described for approximating the length of time required to detect significant differences between treatments on experimental watersheds.

MEASUREMENTS OF CUMULATIVE EVAPORATION FROM BARE SOIL

By F. J. Veihmeyer and F. A. Brooks. Amer. Geophys. Union Trans. 35: 601-607. 1954.

Careful measurements were made of evaporation of soil water during 1951 in California at Davis, Delhi, Mountain View, and Whittier. The soil surface was kept free of vegetation, and no rain fell for periods of 8 to 12 weeks. Analyses of the records indicate that an average curve of evaporation loss against time may be useful for situations where more exact data are not available. Other studies of soil in tanks reveal that, after the first week, the evaporation rate from bare soil without a water table is extremely slow. For 1,547 days during which rain was excluded, the average evaporation rate was 0.00236 inch/day. When water tables were maintained at depths between 0.5 and 5.0 feet, the evaporation loss from uncropped soils

with high water table was not directly proportional to the depth from the soil surface to the water table.

VERTICAL RESOLUTION IN THE NEUTRON METHOD FOR MEASURING SOIL MOISTURE

By C. H. M. van Bavel, E. E. Hood, and N. Underwood. Amer. Geophys. Union Trans. 35: 595-600. 1954.

A source of fast neutrons and a slow neutron-detecting device in proximity were used to measure the moisture content of soil. The work was done with a 10-mc Ra-Be source and a BF₃-filled counter (2.5 X 30 cm.). Rates varied between 16 and 2 counts per second. The vertical extent of the soil layer contributing 95 percent of the measured counting rate ranged from 65 cm. with very dry material (4.4-percent water by volume) to 45 cm. with saturated material (38-percent water by volume). It was shown possible, by partial shielding of the counting tube with cadmium foil to increase vertical resolution, at expense of counting rate. This procedure is not very effective, however.

Climatology

THE NORMAL ANNUAL PATTERN OF MEAN DAILY TEMPERATURES AT EAST LANSING MICHIGAN

By G. A. Crabb, Jr. Mich. Agr. Expt. Sta. Quart. Bul. 36: 401-407. 1954.

This report describes the development of a normal annual pattern of mean daily temperatures at East Lansing, Mich. It is intended as one of a series of papers describing normal patterns of observed hydrologic and meteorologic phenomena at the Michigan Hydrologic Research Station. Wide day-to-day fluctuations noted in the hydrologic records of this station caused such difficulties in comparative analysis of the data that it was necessary to develop a more suitable method of preparing normal annual patterns than those methods in current use. A method of such comparison criteria was developed and applied with considerable success to solar-radiation data. The method was later successfully used to prepare a normal annual pattern of daily evaporation from a free-water surface. It has now been used

in the development of a normal annual pattern of mean daily temperatures. The interdependence of these phenomena has been evaluated through statistical calculation of the correlation coefficient and has been shown to be highly significant in respect to correlation.

A CRITICAL LOOK AT CLOUD SEEDING

By O. P. Cramer. Jour. Forestry. 52: 515-517. 1954.

Although cloud seeding from ground generators has been used in attempts to increase rainfall and reduce fire danger, its effectiveness has not been proved. Seeding from aircraft has demonstrated that certain types of clouds can be altered by certain materials such as silver iodide "smoke" or dry ice. To demonstrate that indirect cloud seeding from ground generators increases the amount of rainfall is, however, much more difficult.

A method of seeding clouds is described which appears to overcome one of the most common objections of the methods now in use.

Sedimentation

SOME OBSERVATIONS ON THE EFFECT OF PARTICLE SHAPE ON THE MOVEMENT OF COARSE SEDIMENTS

By E. W. Lane and E. J. Carlson. Amer. Geophys. Union Trans. 35: 453-462. 1954.

Summarized are the various measurements and analyses that were made on samples of bed material from several canal sections in the San Luis Valley in southern Colorado. Some comparisons are made to show the resistance to movement of various shaped particles according to sphericity and Zingg type. Flat particles tend to become imbricated, and they resist movement more than spherical particles of equal weight. Some observations are made on the effect of dilatancy on scour and sediment movement.

SUSPENDED SEDIMENT DISCHARGE AS RELATED TO STREAMFLOW, TOPOGRAPHY, SOIL AND LAND USE

By H. W. Anderson. Amer. Geophys. Union Trans. 35: 268-281. 1954.

The results of suspended-sediment sampling were used to obtain average an-

nual suspended sediment discharge from 29 watersheds of western Oregon by relating sediment-sampling results to streamflow and by using streamflow frequencies. The values of average suspended sediment thus obtained were related by regression analysis to average watershed values of two streamflow variables, two topographic variables, two soil variables, and one channel bank variable. The soil variables were functions of particle size and aggregation determined by analyzing samples of the surface soil taken at standardized locations in the major geologic types.

The other variables were functions of data published in maps and other secondary sources. The regression results were used (1) to construct a map of the sediment-producing potential of lands in western Oregon under average land use conditions, (2) to estimate how the actual production of sediment would differ from the potential with deviation of land use from average, and (3) to distribute present sediment production to the three major source areas: forest land, agricultural land, and channel banks of the main river.

Ground Water

RIVER DEPLETION RESULTING FROM PUMPING A WELL NEAR A RIVER

By R. E. Glover and G. G. Balmer. Amer. Geophys. Union Trans. 35: 468-470. 1954.

A well adjacent to a river will take a part of its supply from the river. A theoretical formula is developed which permits the draft on the river to be computed in terms of the distance of the well from the river, the properties of the aquifer, and time. The formula applies where the river can be considered to flow in a straight course which extends for a considerable distance both upstream and downstream from the well location.

A NEW FORMULA FOR FLOW INTO PARTIALLY PENETRATING WELLS IN AQUIFERS

By Wen Hsiung Li, P. Bock and G. S. Benton. Amer. Geophys. Union Trans. 35: 805-12. 1954.

The relation between drawdown and yield in an aquifer due to pumping from

a partially penetrating well is approached experimentally, employing the analogy between the flow of electricity and the flow of fluids through porous media. Except for a small area near the well, the drawdown curve of a partially penetrating well has the same shape as that of a fully penetrating well. Outside this small area near the well, the two drawdown curves differ by a constant magnitude which can be found from a simple empirical formula obtained from the experimental data.

WATER-TABLE DRAWDOWN CHARACTERISTICS

By F. R. Hore and E. H. Kidder. Agr. Engin. 35: 396-398. 1954.

Four field methods of measuring the water-table drawdown characteristics were compared to determine whether there were any differences in observational data. Two-inch auger holes, 3/8-inch perforated wells, 2-inch perforated wells, and groups of six 3/8-inch piezometers were installed in parallel rows to a tile drain at varying intervals systematically on each side of the drain. One set of nylon resistance blocks was installed in an attempt to evaluate the methods further.

A statistical analysis of variance revealed significant differences between data from all methods except between data from the 2-inch and 3/8-inch well methods. Observations from cased wells lagged those from uncased wells. Observations from small cased wells lagged those from large cased wells, and the piezometer method was more reliable based on results obtained from the resistant blocks.

MECHANISM OF GROUND WATER RECHARGE

By G. A. Whetstone. Agr. Engin. 35: 646-647. 1954.

Desilting and treating of the recharge area by the addition of organic matter is the most effective method used for recharging ground-water supplies. By using cotton-gin waste, infiltration rates of several times those of undisturbed soil have been obtained.

SOIL AND WATER MANAGEMENT

General

A STUDY OF THE PERSISTANCE OF CMU IN SOIL

By A. J. Loustalot, T. J. Muzik, and H. J. Cruzado. Agr. Chem. 8: 52-53. 1953.

A series of experiments was conducted in the greenhouse and in the field to study the effect of environmental factors on the persistence and movement of CMU (3-para-chlorophenyl-1, 1-dimethylurea) in the soil.

Flats of soil treated with 0, 1, 5, and 10 pounds per acre of CMU were stored for 0, 2, 4, and 10 weeks under various experimental conditions before being planted to corn and velvet beans. The CMU toxicity persisted longer at 10°C. than it did at room temperature or at 45°C., but there was no consistent difference between the two warmer temperatures. As would be expected, the toxicity persisted longer at the higher rates of application at all temperatures. CMU persisted longer in air-dry soil than on soil with a medium or saturated moisture level. Sandy soil retained the toxicity of CMU longer than did soils with a higher clay content. In general, factors favoring soil microbial action seemed also to favor the disappearance of CMU in the soil.

Under field conditions CMU applied at 1 pound per acre remained toxic to velvet beans for 2 weeks, but it was not toxic to corn planted immediately after treatment. Soil treated with 5 pounds per acre remained toxic to both corn and velvet beans for 4 months, and at the 10-pound rate the soil was toxic to corn for 6 months and to velvet beans for 8 months.

ION ACTIVITIES AND OSMOTIC PRESSURES IN CLAY-WATER SYSTEMS

By N. T. Coleman and W. J. Jakobi. Soil. Sci. Soc. Amer. Proc. 18: 19-21. 1954.

Osmotic pressures of H-, Na-, and K-bentonite suspensions were measured with an Adair osmometer. Measurable

osmotic pressures were observed, but the values were quite small, ranging from 0.6 cm. H₂O for 1-percent Na-bentonite to 4.2 cm. H₂O for 4-percent H-bentonite. The ion activity difference across the osmometer membrane, calculated from the membrane potential and the ion concentration on the solution side, was large. The ionic osmotic pressure difference across the membrane, from the van't Hoff approximation was much larger for all systems than was the observed osmotic pressure, leading to the conclusion that the membrane potential cannot be regarded as a measure of an electrostatic potential difference between a clay suspension and its equilibrium dialysate.

Electrolyte mean activities of KCl solutions were consistently slightly smaller than in 2-percent K-bentonite suspensions of the same normality of KCl. Mean activities of KCl in the clay suspensions were much smaller than K⁺ activities measured with a membrane electrode-saturated calomel electrode cell.

The osmotic-pressure data and potentiometric data are interpreted as indicative of a spurious potential at a clay-salt bridge junction.

LOSS OF NITROGEN GAS FROM WATER-LOGGED SOILS

By P. K. De and S. Digar. Jour. Agr. Sci. 44: 129-132. 1954.

When waterlogged soils were treated with nitrogenous manures and fertilizers like oil coke, water hyacinth, ammonium sulphate, and sodium nitrate, a large volume of nitrogen evolved as gas. This loss began 7 to 12 days after application of different treatments and was quicker from inorganic fertilizers than from organic manures. Besides loss as gas, a large amount of nitrogen was also lost in the drainage. The results suggest that if fertilizers like ammonium sulphate and sodium nitrate are applied to ricefields by topdressing during the active vegetative growth of the crop, the loss of nitrogen as gas will probably be greatly minimized.

SOIL MANAGEMENT PRACTICES ON RED BAY FINE SANDY LOAM

By R. W. Lipscomb and W. K. Robertson. Fla. Agr. Expt. Sta. Bul. 537. 1954.

Three years' data from a continuous crop and rotation experiment and a fertility

experiment are reported. The continuous crop vs. rotation experiment contained 13 treatments; namely, five in continuous corn, three in continuous peanuts, three 2-year rotations and two 3-year rotations. The soil fertility experiment consisted of 4 rates of nitrogen, phosphoric acid, and potash applied to 4 cash crops and 1 cover crop in a 3-year rotation. The soil type was primarily Red Bay fine sandy loam. The criterion of response was yield data supported by soil analysis. After peanuts were grown 2 consecutive years with no cover crops, yields decreased 40 percent. Oats and lupines as cover crops grown in the winter between continuous peanut crops helped maintain peanut yields, but there was still a decrease of 10 and 20 percent respectively.

Oats and lupines did not grow well after peanuts. This incompatibility was progressive and depended on the number of times the plants--oats or peanut-lupines combination--appeared in the rotation.

Peanuts grown in 2- or 3-year rotations maintained their initial yield. Cover crops grown in these rotations had no effect on peanut yields. Residual fertilizer was utilized by plants. If the other crops were fertilized in the rotation, peanuts required little fertilizer.

INFLUENCE OF INTEGRATED MOISTURE STRESS ACHIEVED BY VARYING THE OSMOTIC PRESSURE OF CULTURE SOLUTIONS ON GROWTH OF TOMATO AND PEPPER PLANTS

By L. Bernstein and G. A. Pearson. Soil Sci. 77: 355-368. 1954.

The influence of varying moisture-stress regimes having the same mean integrated stress on the growth of pepper and tomato plants was studied by means of water cultures adjusted to various osmotic pressure by the addition of NaCl. In the range up to 12 atmospheres, growth of peppers depended upon mean integrated stress regardless of stress distribution, but tomato plants showed a greater inhibition of growth when stresses in excess of 5 atmospheres contributed to the mean integrated stress than when the stress was 5 atmospheres or less at all times. The implication of these findings with respect to salt tolerance, drought resistance, and irrigation practices are discussed. Data on the mineral composition of tomato and pepper leaves confirm conclusions based

on visual observations that moisture stress and not specific toxicity of sodium or chloride was responsible for diminished growth.

WANTED: FACTUAL DATA FOR EVALUATING THE EFFECT OF WATER CONSERVATION PROGRAMS ON THE LAND

By L. L. Harrold. Jour. Soil and Water Conserv. 9: 128-131. 1954.

Hydrologic research work on watersheds near Coshocton, Ohio, reveal changes in plant cover and land use do have an effect on water intake which, in turn, may influence ground-water recharge to some degree. Plant types that provided complete cover were effective in increasing water intake by about 4 to 6 inches per year over that of row crops such as rotation corn.

Records from cropland lysimeters showed that annual percolation at the 8-foot depth from grassland was 5 inches greater than that from cornland. Reformation of a shallow rooted grass and brush land watershed resulted in 2 inches less streamflow per year. Flood peaks for 10- to 25-year frequency were reduced 20 percent and those for 2- to 5-year frequency reduced 30 to 35 percent.

PROGRESS IN MICHIGAN AGRICULTURE AS MEASURED BY INCREASED CROP YIELDS AND LIVESTOCK PRODUCTION RATES

By J. N. Ferris and E. B. Hill. Mich. Agr. Expt. Sta. Quart. Bul. 36: 245-256. 1954.

This study was undertaken to determine the extent of the increased production of food by Michigan farmers. Yields per acre in crops, per tree for fruits, milk per cow, and eggs per hen were chosen as indicators for these respective farm enterprises.

It was found that corn yields increased from 30.5 bushels per acre from 1909-18 to 37.5 bushels from 1943-52. Because of the increased corn yields, approximately 11,704,000 more bushels of corn were produced on the 1952 acreage (based on 1943-52 yields) than would have been possible if the yields had not increased since 1909-18.

Similar yield and production data are given for other crops and livestock products.

EFFECT OF CULTIVATION ON THE ORGANIC MATTER AND NITROGEN OF BROWN SOILS

By J. L. Doughty, F. D. Cook, and F. G. Warder. Canad. Jour. Agr. Sci. 34: 406-411. 1954.

The brown soils of the prairie area of western Canada lose organic matter and nitrogen very rapidly when put under cultivation. The loss of organic matter is directly related to bacterial activity and the evolution of carbon dioxide. Experimental results are presented showing losses up to 26 percent of the organic matter and 33 percent of the nitrogen from soils under cultivation for 14 years. Only part of the loss of nitrogen can be accounted for by crop removal. Experimental evidence is presented to show that some nitrogen is lost by leaching of nitrates beyond the depth of root penetration. Nitrogen was also lost in some gaseous form, other than as ammonia.

Fertilizers and Soil Fertility

AVAILABLE PHOSPHORUS STATUS OF NEBRASKA SOILS IN RELATION TO SERIES CLASSIFICATION, TIME OF SAMPLING AND METHOD OF MEASUREMENT

By R. A. Olson, M. B. Rhodes, and A. F. Dreier. Agron. Jour. 46: 175-180. 1954.

A study was made to evaluate further the phosphorus status of soils belonging to 15 of the major soil series used for crop production in Nebraska. The textural profile of these soils ranged from fine sand to silty clay, with a pH range of 5.5 to 8.2. Soluble phosphorus measured by four methods, pH and percentage yield response to phosphate were closely related to soil series; thus, good series classification was propounded as a valuable indicator of probable phosphorus fertility status of soil.

The correlation data suggest that very reliable prescriptions for phosphorus supplements can be passed on to farmers over a wide range of soil conditions, strongly acid to highly calcareous and sandy to high in clay content.

Soluble phosphorus measurements throughout the 1952-53 wheat-growing

season at 21 locations by all testing methods showed a marked fluctuation in the so-called available phosphorus status of the soil. A low fall available phosphorus figure was followed by a maximum figure in the spring with a decline thereafter until harvest time. It is believed that soil moisture had considerable to do with this, and allowance must be given for climatic fluctuations in soil test interpretation.

AVAILABILITY OF PHOSPHORUS IN GRANULATED FERTILIZERS

By R. W. Starostka, J. H. Caro, and W. L. Hill. Soil Sci. Soc. Amer. Proc. 18: 67-71. 1954.

A greenhouse test to measure the effect of placement, granule size, and the relative phosphate-fixing capacity of the soil upon the efficiency of superphosphate and dicalcium phosphate was performed. The materials, labeled with P^{32} , granulated, and sized to 4-6, 8-10, 14-20, 28-35, and -35 mesh were used in band and mixed placements on Evesboro and Davidson soils. A major difficulty encountered in greenhouse experimentation with granulated fertilizers stems from the problem of securing small samples for pot application that truly represent the test materials. Even with close-sized materials the minimum representative sample of coarse granules is several-fold larger than the quantity required for pot application. The test crop was wheat. Using increased yields, total phosphorus uptake, and percentage of the plant phosphorus derived from the fertilizer as criteria of agronomic value, the 14-20-mesh granules of superphosphate were the best size tested with this material while the 28-35 and -35 were the best sizes tested with dicalcium phosphate.

A STUDY OF ADAPTATION IN AZOTOBACTER

By J. O. Harris. Soil Sci. Soc. Amer. Proc. 18: 154-159. 1954.

The age of cells was shown to be an important factor in the rate at which Azotobacter chroococcum adapts its respiratory mechanism to using different substrates. These organisms are able to use dilute (M/400) solutions of glucose or mannitol for respiration. Experiments measuring oxygen uptake and dehydrogenase ac-

tivity of intact cells indicated simultaneous oxidation of two substrates is possible by partially adapted cells. Studies of enzymatically active cell-free extracts showed that the Krebs' cycle of terminal oxidation probably occurs in Azotobacter chroococcum. Glucose and mannitol dehydrogenases appeared to be formed only when these compounds were present. This was interpreted as evidence that at least part of the adaptation process is due to formation of new enzyme systems.

EFFECT OF FERTILIZERS APPLIED WITH SEED CORN ON PLANT POPULATION AND YIELDS ON HIGHLY CALCAREOUS CLAY SOILS

By J. W. Collier. Agron. Jour. 46: 118-120. 1954.

In 1950 identical factorial fertilizer experiments with corn were conducted on Houston Black clay and Austin clay, both highly calcareous clay soils. Fertilizer materials and rates included ammonium nitrate (32.5-percent N)--0, 100, 200, and 300 pounds per acre; superphosphate (20-percent P_2O_5)--0, 150, 300 pounds per acre; and muriate of potash (60-percent K_2O)--0 and 100 pounds per acre. All fertilizer materials used in these two experiments were applied in the furrow with the corn seed at time of planting.

The average stand on Austin clay was 87 percent and only 65 percent on Houston Black clay. Effects of fertilizer treatments on plant populations and yields were similar on the two soil types. Relations between rates of ammonium nitrate on both plant populations and yields per acre were linear reductions. Applications of muriate of potash reduced the plant population significantly on Houston Black clay but did not reduce yields significantly on either soil type. Superphosphate applications had practically no effect on plant population and caused small but significant increases in yield on the Houston Black clay. Fertilizer-spacing experiments in which the fertilizers were applied about 3 months before planting were compared with results from a fertilizer experiment in which the fertilizers were applied with the seed. These comparisons indicate that only a small part of the reductions in yield resulting from fertilizer applications with seed may be attributed to reductions in plant population. The major part of the yield reduction is no doubt the result of

retarded emergence and reduced seedling and plant vigor caused by excessive concentrations of salts from the fertilizer materials.

MINERAL COMPOSITION OF APPLE LEAVES IN RELATION TO AVAILABLE NUTRIENT CONTENT OF THE SOIL

By R. L. Wehunt and E. R. Purvis. Soil Sci. 77: 215-218. 1954.

A survey was made of representative commercial apple orchards in New Jersey to determine the degree of association between available nutrients in soils and those taken up by the trees. Correlation coefficients were calculated for 94 pairs of leaf and soil samples collected from apple-producing areas in the State.

A significant correlation coefficient of +0.21 resulted between available soil K and leaf K. Increasing available soil Ca plus Mg plus P depressed the content of K in the leaves. The depressive action of soil Ca plus Mg on leaf K had a higher degree of significance than did soil P. When partial correlations were employed to eliminate the influence of soil Ca plus Mg and soil P on leaf K, a highly significant coefficient of +0.169 was obtained between soil and leaf K. Other results are given also.

EXCHANGEABLE CATIONS IN SOILS OF CALIFORNIA ORANGE ORCHARDS IN RELATION TO YIELD AND SIZE OF FRUIT AND LEAF COMPOSITION

By R. B. Harding. Soil Sci. 77: 119-127. 1954.

The cation contents of soil and leaf tissue of 72 California orange orchards were determined. The orchards included 42 in which fruit sizes were above average and yields were high and 30 in which sizes and yields were poor. Correlation coefficients were calculated for the percentages of potassium, sodium, magnesium, and calcium in the leaf tissue and the amount of these exchangeable cations in the soil. The correlation between leaf potassium and the percentage saturation of potassium in the soil was highly significant. A significant correlation between leaf potassium and total milliequivalents of exchangeable soil potassium was not obtained. Leaf sodium was significantly correlated with milliequivalents of exchangeable sodium in the

soil, as well as with the percentage of saturation.

No significant differences in the means of the cation content of the leaves and soil were found between orange orchards of group 1 (high yields and large fruit sizes) and group 2 (low yields and small fruit) sizes. The results indicate that factors other than excesses or deficiencies of exchangeable soil cations account for production differences between the two orchard groups.

PHOSPHATE RESPONSE, BASE SATURATION AND SILICA RELATIONSHIPS IN ACID SOILS

By H. F. Birch. Jour. Agr. Sci. 43: 229-235. 1953.

The inverse relation described in an earlier publication between phosphate response and the degree of base saturation was confirmed with three further groups of field experiments. As an alternative to the degree of base saturation soil pH may be employed. The discrepancies, sometimes found with the more acid base-unsaturated soils, between actual phosphate responses and those expected from the degree of base saturation were related to the control yields. In general, the higher the control yield on a distinctly acid soil the more the percentage response to phosphate fell short of that expected, and vice versa. By farming multiple regressions of percentage phosphate response on both control yield and the percentage saturation of the B.E.C. a more accurate assessment of phosphate response is possible than by using the simple regression of response on the percentage saturation of the B.E.C. A measurable soil characteristic that could be used in the multiple regressions instead of the control yield was not found.

Very significant and inverse relations were established between percentage phosphate response and the amount of water-soluble or citric acid-soluble silica. These silica contents were also significantly and directly related to the percentage-saturation function similarly in classifying the soils, distinguishing between the almost neutral soils retaining phosphate in an available form associated with exchangeable bases, acid soils with relatively unavailable phosphate associated with iron and aluminum compounds, and soils intermediate between these.

FERTILIZER EVALUATION, QUANTITATIVE EVALUATION OF PROCESSED AND NATURAL PHOSPHATES

By M. Fried. Agr. and Food Chem. 2: 241-244. 1954.

A method is proposed for the quantitative evaluation of fertilizers by means of radioactive tracers. Two classes of fertilizers are examined: processed and natural products. Processed materials can be evaluated by determining the A value of each. In one experiment superphosphate and hydroxylapatite are compared, and in another experiment monocalcium phosphate, resin phosphate, and fused iron phosphate are compared.

Natural products can be evaluated by an A value difference method involving the relative uptake of a standard material in the presence and absence of the natural product. Presented are examples comparing monocalcium phosphate with rock phosphate, and with fused rock phosphate. The method is suggested as a means of quantitatively evaluating the effects of such factors as differences in soil and plant species on the availability of plant nutrients from fertilizers.

PHOSPHORUS CONTENT OF SOILS AND THEIR PARENT ROCKS IN SOUTHERN CALIFORNIA

By D. G. Aldrich and J. R. Buchanan. Soil Sci. 77: 369-376. 1954.

Water-soluble, acid-soluble, and total phosphorus contents of 140 unfertilized soils in southern California were studied. These soils represent 47 different soil series and involve 9 profile groups set up on the basis of topography, mode of formation, and age or degree of profile development.

Defective levels of water-soluble phosphorus and acid-soluble phosphorus obtained according to the Bingham and Truog procedures, respectively, were found in every profile group. A highly significant correlation was found between acid-extractable phosphorus and total phosphorus when all the soils of the survey were involved. An insignificant correlation was obtained when the analysis was confined to individual profile groups. No correlation could be found between water-soluble phosphorus and total phosphorus.

COBALT INVESTIGATIONS ON SOME NOVA SCOTIA SOILS

By J. R. Wright and K. Lawton. Soil Sci. 77: 95-105. 1954.

Greenhouse and laboratory studies were conducted on 14 Nova Scotia soils to determine their cobalt status and the influence of dolomitic limestone and cobalt on the yield and cobalt content of oats and timothy. In addition, the effects of gypsum, copper, and varied rates of nitrogen, phosphorus, potassium dolomite, and cobalt on the yield and cobalt content of timothy grown on Woodville sandy loam were studied.

The soils ranged in texture from sandy loam to clay and in cobalt content from 3.6 to 21.0 p.p.m. The cobalt content of the soils was significantly correlated with texture and cation-exchange capacity but not with organic-matter content, pH, percentage base saturation, or exchangeable calcium or magnesium.

There was a significant relation between the cobalt content of the oat plant and soil pH and texture, but not with cation-exchange capacity or organic-matter content. There was no correlation between the cobalt content of the soils and that of the oat and timothy crops grown on them.

Dolomite caused a significant decrease in the uptake of native soil cobalt by the oat plants. The plant uptake of cobalt applied to the soil was markedly reduced by application of dolomitic limestone.

PHOSPHORUS STATUS OF PEAT SOILS IN BRITISH GUIANA

By H. Paul. Soil Sci. 77: 87-93. 1954.

A preliminary investigation was made of the phosphorus status of the peat soils in British Guiana before and after cropping. Preliminary field experiments adduced strong evidence in support of complaints of farmers that the productivity of pegasse soils were considerably impaired by continuous cropping for a comparatively short period.

The total phosphorus and the available phosphorus of the virgin soil are greater than those of the exhausted soil. More than 70 percent of the total phosphorus of these soils is present as organic and inorganic alkali-soluble forms. Comparison with virgin soil of high productivity indicated that these two fractions of

phosphorus in pegasse soils are diminished on cropping.

PLANT UPTAKE OF ZINC 65 FROM SOILS AND FERTILIZERS IN THE GREENHOUSE

By E. Shaw, R. G. Menzel, and L. A. Dean. Soil Sci. 77: 205-214. 1954.

Zinc 65 was used in a series of experiments in the greenhouse to study the plant uptake of zinc from different sources. Percentage utilization of the zinc fertilizers was inversely related to the rate of application, but in all cases was very low. There was very little difference in utilization from freshly applied $ZnSO_4$, the less soluble $ZnCO_3$, zinc applied as plant material, and the zinc accumulated in the soil from applications of $ZnSO_4$ during the previous 5 years. Utilization of zinc from $ZnSO_4$ by citrus seedlings and corn was very similar. In both crops, zinc mixed with the soil was used slightly more efficiently than when applied in bands.

In corn the zinc supplied by the seed furnished an important part of the plant's zinc, particularly when the soil zinc supply was low. There was evidence that zinc was not readily redistributed within the plant. Zinc in the older tissues was less mobile when the plants were grown on soil adequately supplied with zinc.

AVAILABILITY OF SOIL MOLYBDENUM AS SHOWN BY THE MOLYBDENUM CONTENT OF MANY DIFFERENT PLANTS

By W. O. Robinson and G. Edgington. Soil Sci. 77: 237-251. 1954.

Twenty-five surface soils, mainly from the Piedmont regions of Maryland and Virginia, were analyzed for total molybdenum. From these sites 160 plant samples were analyzed for the same element. From these data the availability of the soil molybdenum to a considerable number of plants on the same and different soil sites have been compared. Different plants take up very different amounts of molybdenum from the same soil site. In general, the most fertile soils furnish the most available molybdenum to the average plant. On the average, smartweed and jimson weed took up more molybdenum than did red clover, and lespedeza took up less than one-tenth of the molybdenum taken up by any of the 3 aforementioned plants.

The hypothesis is advanced that the free hydrated ferric oxides in the soil make the soil molybdenum less available to plants and that large, indurated iron concretions may lock up a comparatively large amount of molybdenum in an entirely unavailable condition.

EFFECT OF VARIOUS EXCHANGEABLE CATION RATIOS ON KINDS OF FUNGI DEVELOPING DURING DECOMPOSITION OF ORGANIC RESIDUES IN SOIL

By J. P. Martin and D. G. Aldrich. Soil Sci. Soc. Amer. Proc. 18: 160-164. 1954.

Soils varying widely in exchangeable Ca, Mg, K, Na and H ratios were prepared from Yolo loam and Hanford sandy loam soils. The effect of these ratios on the kinds of soil fungi developing during the decomposition of organic residues in the soil was followed at various intervals over a 200-day incubation period.

In general, the nature of the organic material added to the soils exerted a greater effect on the kinds of fungi developing than did the exchangeable cation ratios.

SEPARATION OF ORGANIC ACIDS FROM SEVERAL DORMANT AND INCUBATED OHIO SOILS

By S. M. Schwartz, J. E. Varner, and J. P. Martin. Soil Sci. Soc. Amer. Proc. 18: 174-177. 1954.

The objectives of this study were to determine the organic-acid content of several grey-brown Podzolic soils in Ohio and to study changes in the acids occurring as a result of short period aerobic incubations of the soil materials at constant temperature and moisture. The soil materials used in this investigation, Brookston silty clay loam, Crosby silt loam, Miami silt loam, and Wooster silt loam, were obtained from naturally wooded areas in the State.

A 1-percent glucose treatment of the several soil materials apparently did not appreciably change the organic acid makeup either qualitatively or quantitatively. Preliminary data are presented concerning the effect of incubation on phosphorus solubility.

SMALL GRAIN FERTILIZER TESTS ON HOUSTON SOILS OF NORTH-CENTRAL TEXAS, 1949-1952.

By C. O. Spence, A. A. Baltensperger, and D. I. Dudley. Tex. Agr. Expt. Sta. Prog. Rpt. 1668. 1954.

The average yield of wheat at 27 locations 1949-52 without fertilizer was 14.3 bushels. The use of 30 pounds of nitrogen as a topdressing gave an average yield of 24 bushels of wheat per acre. Oats grown at 14 locations during the same years yielded 33.1 bushels of grain per acre without nitrogen fertilizer and 57.3 when 30 pounds of nitrogen were applied. Average increases per acre from the nitrogen applications were 9.7 bushels of wheat and 24.2 bushels of oats, or increases of 68 and 72 percent, respectively.

LEGUME NITROGEN VERSUS FERTILIZER NITROGEN IN PROTEIN PRODUCTION OF FORAGE

By R. E. Wagner. Agron. Jour. 46: 233-237. 1954.

During 1949 and 1950, field-plot studies were conducted at Beltsville, Md., to compare mixed seedings of orchardgrass-Ladino clover and tall fescue-Ladino clover with their individual components and bromegrass grown in pure stand with and without nitrogen. Factors studied included protein percentage at various seasons of the year, total protein percentage at various seasons of the year, total production and distribution of protein yield through the season.

Orchardgrass and tall fescue responded markedly in protein percentage and yield to applications of nitrogen. Both grasses used high proportions of the applied nitrogen.

The mixed seedings produced more total protein than did the grass in pure stand fertilized with as much as 160 pounds per acre of nitrogen. Distribution of production through the season was superior in the mixtures. Ladino clover fixed as the average more than 150 pounds per acre annually of utilizable nitrogen when grown with orchardgrass or tall fescue.

Bromegrass with or without nitrogen was exceptionally weedy and low in protein production. Nitrogen applied to Ladino clover actually decreased protein production because of increased weed competition.

THE DISSOLUTION AND MIGRATION OF PHOSPHORUS FROM GRANULAR SUPERPHOSPHATE IN SOME MICHIGAN SOILS

By K. Lawton and J. A. Vomocil. Soil Sci. Soc. Amer. Proc. 18: 26-32. 1954.

The purpose of this study was to determine the rate of dissolution and migration of phosphorus from granular superphosphate under different soil conditions. The effect of variation in soil type, soil moisture, compaction, and soluble phosphorus level in soils was considered. Laboratory studies were conducted in which fertilizer granules in contact with moist soil was experimentally verified. At field capacity moisture contents, 50 to 80 percent of water-soluble phosphorus moved out of the granules in 24 hours. Even in soils as low as 2-to 4-percent moisture, approximately 20 to 50 percent of the phosphorus moved from the granules into the soil in 1 day. Both commercial and experimental superphosphate 4-8-mesh granules had a strong tendency to absorb moisture when placed in a saturated atmosphere. In relatively dry soils, moisture is drawn from the soil mass toward the granule, thereby forming a moist shell.

THE EFFECT OF ANHYDROUS AMMONIA ON NITRIFICATION AND THE MICROBIOLOGICAL POPULATION IN SANDY SOILS

By C. F. Eno and W. G. Blue. Soil Sci. Soc. Amer. Proc. 18: 178-181. 1954.

Anhydrous ammonia was applied to Arredondo loamy fine sand and Lakeland fine sand at the rates of 100 and 250 pounds of nitrogen per acre. In all soils the numbers of fungi were decreased. The numbers of bacteria and actinomycetes were increased except for a period not longer than 3 days after application, on the neutral soil, during which time they were decreased. A more detailed study of the zone of retention showed that both the numbers of fungi and bacteria decreased on the first day. This decrease occurred in both acid and neutral soil. On the 10th day the numbers of fungi were still markedly reduced, whereas the numbers of bacteria had increased 6 to 25 times those in the check soil. The changes in the microbiological population were noticeable while high concentrations of ammonia were present and were restricted

to a 3-inch zone centered on the injector row; this corresponded to the zone in which most of the ammonia was retained. From a total population standpoint, none of the changes noted are likely to permanently disturb the ecological balance in the soil.

The drastic reduction in numbers of fungi in the anhydrous ammonia-treated soil indicated that there may be a possibility of it being used as a fungicidal agent in the soil. Compared to ammonium sulfate, anhydrous ammonia nitrified more rapidly in the slightly acid soils and less rapidly in the neutral soil. This may be of practical significance in choosing between these two fertilizer materials.

EFFECT OF LIME ON THE AVAILABILITY OF PHOSPHORUS IN SOILS OF HIGH TO LOW SESQUIOXIDE CONTENT

By W. K. Robertson, J. R. Neller, and F. D. Bartlett. Soil Sci. Soc. Amer. Proc. 18: 184-187. 1954.

The effect of rates of lime and phosphorus were tested on 3 virgin and 3 cropped Florida soils over a wide range of sesquioxide and phosphorus contents. The experiment was set up in the greenhouse. Lime was applied to get a wide range of pH levels. Oat and corn yield data and the percent recovery of applied phosphorus tagged with P^{32} were the criterion of response.

Liming soils relatively low in residual phosphorus increased the availability of applied phosphorus up to pH 6 to 6.5 when the sesquioxides were high but had no effect where the sesquioxides were low. Liming these soils above 6 to 6.5 caused the percentage of phosphorus in the plant from the fertilizer to level off or decline, probably due to the formation of relatively unavailable tricalcium phosphate. Liming soils high in residual phosphorus reduced the availability of fertilizer phosphate regardless of the sesquioxide content. Uptake of phosphorus from currently applied superphosphate was highest from the soils high in sesquioxide content irrespective of rate of liming.

THE PRESENCE OF ROOT INHIBITION SUBSTANCES IN COW URINE AND THE CAUSE OF URINE BURN

By B. W. Doak. Jour. Agr. Sci. 44: 133-139. 1954.

A study was made to determine the cause of urine burn in pastures. It was

shown that urine burn could occur under dry-soil conditions due to the osmotic pressure effects of urine. All seeds present in the urine-affected soil were killed. An inhibitor of root growth, to which clover roots were especially sensitive, was present in the urine of cows and sheep. This inhibitor, which is not heteroauxin, is acid in character and is destroyed in soil in a few days. It is suggested that the inhibitor is an inhibitor-auxin complex, of which the auxin portion might be heteroauxin. The possibility that the inhibitor is an auxin precursor is discussed.

The reduction in clover growth relative to grass growth in a urine patch is not simply the result of shading due to increased grass growth. The root inhibitor, the temporarily high pH, the presence of free ammonia, and the high concentration of ammonium ions may be important factors in the reduction of clover growth.

IDENTIFICATION OF LIME-DEFICIENT PEAT SOILS

By I. J. Nygard. Soil Sci. Soc. Amer. Proc. 18: 188-192. 1954.

Field and laboratory studies were made of 37 Minnesota peat bogs to fix the upper limit of lime content in the surface of lime-deficient bogs, and to determine criteria of lime-deficient peats other than the lime content. Field trials to determine whether the peats were lime-deficient, using common farm crops, were conducted on peats from 35 uncultivated bogs and 2 cultivated bogs. All lime-deficient peats and most of the lime-sufficient peats were extremely acid as indicated by pH measurements. A close correlation existed between the lime (calcium oxide) content and lime-deficiency. No native plant species were found to indicate lime-deficiency reliably.

THE RELATIONSHIP IN ACID SOILS BETWEEN BASE SATURATION AND PHOSPHORUS UPTAKE BY GRASSES

By H. F. Birch. Jour. Agr. Sci. 43: 329-333. 1953.

Analyses of grass samples from 17 fertilizer trials on acid soils showed that both the percentage phosphorus in the grass and the amount of phosphate removed by the crops were significantly and directly related to the percentage saturation of the B.E.C. of the soil. The amount

of acid-soluble phosphate by difference was also significantly and directly related to the percentage phosphate in the grass but not to the amount taken up by the crop. The amounts of exchangeable bases, exchangeable calcium and acid-soluble, and adsorbed and water-soluble forms of phosphate showed no significant relation with phosphate uptake and percentage in the grass. The percentage saturation of the B.E.C. was found to be, on the average, about five times as effective as a contributory factor to the percentage phosphate in the grass as the amount of acid-soluble phosphate by difference.

FERTILITY EXPERIMENTS WITH FIELD CORN ON EVERGLADES PEATY MUCK SOIL

By W. T. Forsee, Jr., V. E. Green, Jr., and R. H. Webster. Soil Sci. Soc. Amer. Proc. 18: 76-79. 1954.

Fertility experiments have been conducted with field corn on Everglades peaty muck soils to determine the required fertilizer program with respect to P_2O_5 and K_2O .

Four experiments have been conducted involving potash, phosphate experiments laid out in randomized block designs, and nitrogen, potash, phosphate experiments laid out in $3 \times 3 \times 3$ factorial designs. Soil tests were used to determine the P_2O_5 and K_2O levels in the soil and tissue tests were conducted to measure the uptake of these nutrients from the soils. These data have been correlated with yields to furnish the necessary information on which to base fertilizer recommendations from the results of soil or tissue tests.

The corn showed yield responses to increasing levels of potash in the soil up to values as high as approximately 70 pounds potassium per acre as determined by the soil tests. The yields ranged from 26 bushels per acre at the lowest K_2O levels to 63 bushels at the level of maximum response which produced plants that gave stem tissue tests averaging approximately 5.00-percent potassium, moisture free basis. Potash deficient corn gave tissue tests as low as 2.72-percent potassium.

WHEAT YIELDS AND SOIL FERTILITY ON THE CANADIAN PRAIRIES AFTER A HALF CENTURY OF FARMING

By K. W. Hill. Soil Sci. Soc. Amer. Proc. 18: 182-187. 1954.

At three experimental stations in Western Canada, the yields of spring wheat on summerfallow in grain rotations have been maintained for 40 years without the addition of fertilizer or manure. Yields of wheat following wheat in these rotations at two stations may have declined slightly but this was not due entirely to reduced fertility since weed infestations have adversely affected yields.

At the Lethbridge station in Alberta, average losses of 25-percent nitrogen and 19-percent organic matter have occurred in the grain rotations since 1910. It appears that a cropping practice which includes wheat and summerfallow can be continued profitably for some time to come in Western Canada if soil erosion and weeds can be controlled.

WHEAT FERTILIZATION STUDIES IN WESTERN OKLAHOMA, PROGRESS REPORT, 1951-52 and 1952-53.

By H. V. Eck and B. A. Stewart. Okla. Agr. Col. and U. S. Dept. Agr., Agr. Res. Serv. Bul. B-432. 1954.

Uniform wheat fertility experiments were started in western Oklahoma in the fall of 1951. Additional experiments were started in 1952 and 1953. The purpose of these experiments is to determine the kind and rate of fertilizer needed, and the best time for applying it.

Nitrogen fertilization brought about significant increases in yield at 7 of 8 locations in the 1951-52 season. In 1952-53, nitrogen response was realized at only 1 location.

Yields increased with the amount of nitrogen applied through 80 pounds per acre in the 1951-52 season. The most economical rate, 40 pounds per acre, gave an average yield increase of 10 bushels per acre at 7 of 8 locations.

FURNACE SLAG AS A SOURCE OF PLANT NUTRIENTS AND ITS LIMING EFFECTIVENESS RELATIVE TO LIMESTONE

By P. P. Chichilo, W. H. Armiger, A. W. Specht, and C. W. Whittaker. *Agr. and Food Chem.* 2: 458-462. 1954.

On Fallsington heavy loam soil slag liming produced crops containing, percentage-wise, 2 to 4 times as much manganese, less calcium, and frequently more copper. On this soil and on Norfolk sandy loam soil slag liming produced crops containing up to 2.5 times as much magnesium and significantly more boron. Aluminum, iron, and sodium contents were unaffected within the accuracy of the tests, and those of phosphorus and potassium in only a few comparisons.

As judged by yield and soil pH, the slag was as effective as a liming material on the Norfolk soil as the limestone, but the latter was more effective on the Fallsington soil.

Nearly all results were strongly affected by the type of soil used and it is believed that generalizations as to the relative merits of slag and limestone for liming the soil, as well as their effects on crop composition, should be made with caution until the soil factor is better understood.

GRAIN SORGHUM FERTILIZER TRIALS, HIGH PLAINS OF TEXAS, 1953

By J. Box and D. L. Jones. *Tex. Agr. Expt. Sta. Prog. Rpt.* 1700. 1954.

The rate of 80 pounds of available nitrogen per acre gave a significant increase in yield. The maximum increase, however, was only 470 pounds over the check, which yielded about 5,000 pounds per acre. Because color differences showed up near the end of the growing season, continued heavy yields might require the addition of a nitrogen fertilizer. However, fertilizer generally cannot be recommended for grain-sorghum production in this area.

SOIL FERTILITY LEVELS OF GRASSLAND IN SOME DAIRY SECTIONS OF THE NORTHEAST

By R. R. Robinson, L. J. Cotnoir, Jr., C. H. Moran, E. R. Purvis, W. A. Mitcheltree, H. G. Allbritten, I. H. Stuckey, and M. Salmon. *Agron. Jour.* 45:371-376. 1953.

A survey of levels of soil fertility on 50 dairy farms in selected areas in Maine,

Rhode Island, New Jersey, and Delaware showed wide variations in organic matter, pH value, and available phosphorus, potassium, calcium, and magnesium. Highly significant differences, however, were associated with depth of sampling, land use, and areas in each of the tests.

THE EFFECT OF NITROGEN ADDITIONS ON FERTILIZER PHOSPHATE AVAILABILITY

By D. A. Rennie and J. Mitchell. *Canad. Jour. Agr. Sci.* 34: 353-363. 1954.

On fallow, there was no indication of any significant increase in yield due to the nitrogen addition, even when NH_4NO_3 was added in relatively large amounts (30 pounds N per acre). Thus it seems unlikely that the nutritive value of the nitrogen is responsible for the superiority of ammonium phosphate (11-48-0) over other phosphate fertilizers in this region.

Marked increases in the uptake of fertilizer phosphate from both carriers (11-48-0 and T.S.P.) occurred as the amount of added nitrogen was increased. If, for example, sufficient nitrogen is added to T.S.P., the uptake of phosphorus from this basic fertilizer can be enhanced to a point where it exceeds that of the highly available 11-48-0. A lowering of the pH in the vicinity of the fertilizer due to the addition of an acid-forming product such as NH_4NO_3 was suggested as a reason for this marked increase in availability. The ammonium ion content of the ammonium phosphate carrier would similarly increase the availability in high base status soils.

Stubble trash reduced fertilizer availability considerably. This reduction in availability was partially overcome by the addition of nitrogen to the carriers.

FERTILITY STUDIES ON SOIL TYPES. IV. POTASSIUM SUPPLY AND REQUIREMENT AS SHOWN BY GREENHOUSE STUDIES AND LABORATORY TESTS

By R. F. Bishop, A. J. MacLean, and L. E. Lutwick. *Canad. Jour. Agr. Sci.* 34: 374-384. 1954.

Oats and alfalfa were grown in the greenhouse on samples of surface soil taken from 9 farms on each of 10 soil types occurring in the Ottawa district. The effect of applied potassium, as shown

by alfalfa yields and the combined uptake of potassium by oats and alfalfa, was used as a basis for evaluating the Neubauer procedure and two chemical procedures as methods for estimating the soil potassium available for plant growth.

The relative effect of applied potassium on the uptake of potassium varied significantly according to soil type. The amounts of potassium extracted from surface soil samples, by each of the three methods employed, varied significantly between soil types. Correlation coefficients, expressing the relation between clay content and soil potassium extracted, were highly significant for each of the three methods.

The correlation coefficients relating the uptake of potassium by the crops and the results obtained by the three methods employed were highly significant.

MANGANESE STUDIES WITH SOME NEW JERSEY SOILS

By S. J. Toth and E. M. Romney. Soil Sci. 78: 295-303. 1954.

Detailed studies of the distribution of various forms of Mn in separates of two soils, the Mn-supplying power of New Jersey soils, content of Mn in various plant species grown under identical soil conditions, and the effect of high levels of Co, Fe, Mo, Ni, and Zn were made in the laboratory, greenhouse, and field. The most important findings were:

Exchangeable, easily reducible, and total Mn contents of the sand, silt, and clay separates of Collington sandy clay loam soil decreased with depth, but those of Sassafras loam soil increased with depth.

Soils formed in the Appalachian Province of New Jersey supplied more Mn to soybeans than did those of the Coastal Plain Province.

THE RELATIONSHIPS AMONG CORN YIELDS, LEAF COMPOSITION AND FERTILIZER APPLIED

By F. G. Viets, Jr., C. E. Nelson, and C. L. Crawford. Soil Sci. Soc. Amer. Proc. 18: 297-301. 1954.

The purpose of this study was to determine the effect of fertilizer application on corn yields and the composition of certain leaves, and the relation between leaf com-

position and yields. Three experiments differing in details were conducted under irrigation with hybrid Iowa 939 corn in central Washington.

Leaves were selected at several growth stages, but the second leaf below the ear collected at silking was studied most intensively. Analyses were made for total N, P, Ca, Mg, K and Mn, and for P soluble in 2-percent acetic acid. Only N increased yields significantly; K and P applications did not. Calcium nitrate was least effective of the five N sources used. Total N content of leaves selected prior to silking gave lower correlations with yield than those selected at silking. Yields were highly positively correlated with both N and total P contents of leaves selected at silking, and total P and N contents of leaves were also highly correlated. Partial regression analysis showed that leaf N was probably the dominant determinant of yield, but that the leaf P content was sometimes important.

For the three experiments the regression coefficients of yield on leaf N content were not significantly different, but the intercepts were markedly different.

SOIL FACTORS AFFECTING MOLYBDENUM UPTAKE BY CAULIFLOWER

By N. Gammon, Jr., G. M. Volk, E. N. McCubbin, and A. H. Eddins. Soil Sci. Soc. Amer. Proc. 18: 302-305. 1954.

Molybdenum deficiency of cauliflower (whiptail) has been observed on the acid (pH 4.2-5.0) flatwoods soils of Florida. Considerable differences have been noted between cauliflower varieties in their development of molybdenum deficiency symptoms on these soils. Direct applications of molybdenum with and without lime were used as means of correcting the deficiency. Soil and plant analyses indicate that these soils can supply an adequate amount of molybdenum for plant growth by increasing the soil pH.

The growing of cauliflower seedlings in acid heavily fertilized soils limits the molybdenum taken up by the plant. These plants are set in the field in acid soils made even more acid by current fertilization. The plants with low molybdenum content and root systems restricted by transplanting are set in a soil with a low molybdenum supplying power. These conditions result in a temporary molybdenum deficiency in the plants. Subsequently,

this deficiency becomes apparent when the damaged buds develop and the whiptailed leaves appear. As the roots grow and the acidity from the fertilizer dissipates, conditions become more favorable for molybdenum uptake by the plants.

The degree of bud damage and the subsequent availability of molybdenum to the plants will be major factors in determining the degree of recovery and production of marketable heads by the plants. Failure of the leaves to develop chlorosis is further evidence of the temporary nature of the deficiency.

SOLUTION-CULTURE STUDIES OF NITRITE TOXICITY TO PLANTS

By F. T. Bingham, H. D. Chapman, and A. L. Pugh. *Soil Sci. Soc. Amer. Proc.* 18: 305-308. 1954.

Solution-culture studies of the toxicity of nitrites to plants were undertaken, using several rapidly growing species as indicator plants. Three to four weeks' growth of the test plants in complete nutrient solutions containing graded amounts of nitrous acid, (varying nitrite and pH levels) disclosed that growth inhibition in the pH 4.0, 5.0, and 6.0 solutions was related to the undissociated nitrous acid fraction.

Experiments with tomato plants suggested that a given concentration of nitrous acid is less injurious to the plant when the nitrogen assimilable by the plant is supplied as nitrate rather than as ammonium.

PLACEMENT OF FERTILIZERS FOR POTATOES PLANTED BY MACHINES

By G. W. Cooke, M. V. Jackson, and F. V. Widdowson. *Jour. Agr. Sci.* 44: 327-339. 1954.

A two-row hand-dropping potato planter was modified by adding fertilizer equipment. The machine was used in 33 experiments in 1951 and 1952 to plant potatoes from flatland and compare broadcast dressings of granulated compound fertilizer with dressing placed near to the seed.

Fertilizer placed either in one band at the side and below the level of the seed, or in contact with the seed, gave consistently higher yields than broadcast dressings. Broadcast fertilizer gave yields similar to those given by only one-half to two-thirds as much placed fertilizer. On the average of all the experiments, placing

fertilizer gave about 1 ton/acre more potatoes than broadcasting. The advantage of placement were greatest when low rates of dressing were used.

FACTORS AFFECTING THE FOLIAR ABSORPTION OF N¹⁵ LABELED UREA BY TOBACCO

By R. Volk and C. McAuliffe. *Soil Sci. Soc. Amer. Proc.* 18: 308-312. 1954.

Single leaves of Dixie Bright 101 tobacco plants grown in sand culture in the greenhouse were sprayed with N¹⁵ labeled urea. Up to 5 mg. of the 15 mg. of nitrogen applied was absorbed by the leaf within 24 hours, and by 6 hours part of this nitrogen had been translocated to every plant part. One-half of the absorbed nitrogen was translocated from the sprayed leaf by 24 hours, chiefly to adjacent leaves, the meristem and root.

The absorption of urea was nearly identical through the upper and lower leaf surfaces. Absorption decreased with increasing vertical leaf position with the exception of the uppermost leaves and irrespective of the leaf area. Leaf maturity had little effect if the relative leaf position was the same. However, very young plants did absorb more nitrogen than more mature plants.

Damaging the epidermal hairs by gentle brushing with a camel's hairbrush increased absorption of urea tenfold. Such brushing ruptured the impermeable cutinized layer of the epidermal hairs permitting the urea solution to come into direct contact with the epidermal cell wall. Absorption of urea over a 4-hour period was found to be 3 to 10 times greater during the night than during the day. Absorption was also 3 times greater in the morning than in the afternoon. This suggests that internal factors in the leaf which undergo diurnal fluctuations may play an important role in foliar absorption of urea.

RESPONSE OF SUGAR BEETS TO POTASSIUM FERTILIZATION IN RELATION TO SOIL PHYSICAL AND MOISTURE CONDITIONS

By W. E. Larson. *Soil Sci. Soc. Amer. Proc.* 18: 313-317. 1954.

The relation existing between the effects of potash fertilizers, physical and chemical properties of the soils and

moisture tension treatments on the yield, and potassium and sodium uptake by sugar beets in south central Montana have been studied.

Small sugar beet yield increases due to potash fertilizer were obtained on calcareous soils containing quantities of exchangeable potassium much in excess of what is usually thought to be adequate for maximum growth (i. e. from 0.82 to 1.79 m. e. per 100 grams soil).

Another experiment having moisture-tension variables was conducted on a soil with relatively few large pores particularly at the 6-inch depth. Late in the season, sugar beets growing on low tension treatments showed evidence of potassium deficiency, and petioles contained 31 percent less potassium than petioles from high tension treatments.

Since yield increases due to potash were obtained on soils with a very few large pores and maintained at low moisture tensions, poor soil aeration was a major factor contributing to the low potash availability. The lack of any relation between potassium uptake and the amounts exchangeable suggests potassium absorption was dependent on soil aeration.

EFFECT OF NITROGEN FERTILIZER ON THE NITROGEN, PHOSPHORUS, AND CATION CONTENTS OF BROMEGRASS

By J. S. Russell, C. W. Bourg, and H. F. Rhoades. Soil Sci. Soc. Amer. Proc. 18: 292-296. 1954.

Heavy applications of nitrogen fertilizer produce large increases in growth of brome grass on nitrogen-deficient soils in eastern Nebraska. Such a marked effect of nitrogen fertilizer upon growth may also be reflected in the composition of the forage according to results from Rokeby soils at Lincoln, Nebr. Rates of 0, 60, 120, and 240 lbs. N/acre were applied to a sod-bound field of Lincoln brome grass. Yields of forage and plant samples were obtained four times during the growing season during 1 year, and once at the regular time of harvesting hay during other years.

Plant samples were analyzed for nitrogen, phosphorus, calcium, magnesium, potassium, and sodium. There was a general decrease in percentage of all elements throughout the growth period sampled, although the trends varied with the element and with the treatment. Nitrogen percent-

age was higher for fertilized than nonfertilized brome grass at all stages of growth. During early stages of growth, phosphorus percentage was greater in the fertilized than the nonfertilized forage but at final harvest there was a tendency for the reverse to be true. There was a noticeable increase in potassium percentage with some decreases in percentages of calcium and magnesium due to fertilization. The increase in potassium percentage was, however, greater than the decreases in calcium and magnesium percentages so there was an increase in milliequivalents of total cations.

HOW ACCURATE IS A SUMMARY OF SOIL TEST INFORMATION?

By R. E. McCollum and W. L. Nelson. Soil Sci. Soc. Amer. Proc. 18: 287-292. 1954.

Chemical analyses of soils from 1,184 systematically sampled fields in Duplin County, N. C., were compared with results from 538 voluntary farmer samples sent into the Soil Testing Division. Cropping history for fields included in both samples was obtained by personal contact and by correspondence, respectively. Results were compared on the basis of the previous crop as well as on the basis of the general mean of the two samples.

The pH and content of organic matter and potassium were significantly higher in the farmer samples but the differences were small in magnitude. The calcium and magnesium were distinctly higher in the farmer samples. On the other hand, the phosphorus was significantly lower in the farmer sample, but again the difference was small. The tendency for higher levels of pH, potassium, calcium, and magnesium may serve to substantiate the idea that the better farmers are sending in the majority of the samples. However, the difference in results for pH, organic matter, phosphorus, and potassium is not considered sufficiently great to invalidate a summary of results from farmer samples. Seasonal effects on values obtained for pH, phosphorus, and potassium present a problem. However, assuming the same type of seasonal distribution from year to year and the same type of farmers sending in samples, relative differences among areas, among crops, or in trends can be established.

EFFECT OF AMMONIA AND ITS OXIDATION PRODUCTS ON RATE OF NITRIFICATION AND PLANT GROWTH.

By P. C. Duisberg and T. F. Buehrer.
Soil Sci. 78: 27-39. 1954.

A comparative study was made of the changes in soil during nitrification of ammonia applied by injection and in irrigation water. The distribution of ammonia was uniform in the injected samples, but showed considerable nonuniformity in the water applied. This disparity was found to delay the oxidation of nitrite and allowed nitrites to accumulate. Studies on the response of barley to ammonia applied by injection to Gila fine sandy loam showed that germination was complete at all concentrations up to 450 p.p.m. $\text{NH}_4\text{-N}$ during the first 10 days. Dry weight and nitrogen uptake by barley increased with concentration of $\text{NH}_4\text{-N}$ applied up to 260 p.p.m. but decreased rapidly beyond this concentration. Nitrite ion had no apparent toxic effect upon the plants.

Nitrification of ammonia proceeded at about the same rate in presence of growing barley plants as in treated soil alone, but nitrites accumulate to a higher level of concentration in absence of the growing plants.

UTILIZATION OF PHOSPHORUS BY SUGAR BEETS AS AFFECTED BY FERTILIZER PLACEMENT

By K. Lawton, A. E. Erickson, and L. S. Robertson. Agron. Jour. 46: 262-264. 1954.

A field experiment was conducted to determine the effect of fertilizer placement on the yield and fertilizer phosphorus uptake by sugar beets. A complete mixed fertilizer containing ammoniated superphosphate tagged with P^{32} was applied to a Brookston clay loam soil by three placement methods, including banding, drilling, and sidedressing.

In the first 2 months of growth, sugar-beet tops and roots obtained the highest percentage of fertilizer phosphorus from fertilizer applied in a band below and to the side of the seed. With increased lateral growth of roots in July and August the uptake of fertilizer phosphorus was highest in beet tops and roots from plots receiving fertilizer in 7-inch drill rows. Phosphate fertilizer sidedressed along

sugar-beet rows approximately 2 months after planting was rapidly absorbed by the sugar-beet plant. One month after the sidedressed application, fertilizer phosphorus constituted about 40 percent of the total plant phosphorus. Significant yield response was obtained from phosphate fertilizer with all methods of placement. Although higher average yields were obtained from split application placements, the data indicate that yield differences between single and split application fertilizer placements were not statistically significant.

DIFUSION OF FERTILIZER PHOSPHORUS IN SOILS

By J. M. Heslep and C. A. Black. Soil Sci. 78: 389-401. 1954.

One-dimensional diffusion of P from solid phosphatic fertilizers into adjacent soil was investigated in experiments employing fertilizers tagged with P^{32} . The distance of diffusion of P from superphosphate and monobasic ammonium phosphate from the fertilizer source was found to increase with time of diffusion and rate of P addition. In 4 weeks the fertilizer P did not diffuse more than 3 or 4 cm. from the source, even with rates of P_2O_5 addition as great as 369 mg. per square centimeter of cross-sectional area of the diffusion cylinder. Often more than 50 percent of the fertilizer P found in the soil after 4 weeks had diffused within the first week, and more than 90 percent within the first 3 weeks. Reaction of the diffusing P with the soil was presumably responsible for failure of the process of diffusion in soil to follow the simple theory of free diffusion.

SURFACTANTS IN FERTILIZERS, USE OF SURFACE ACTIVE AGENTS IN PHOSPHATE ROCK ACIDULATION

By E. J. Fox, H. E. Batson, Jr., and A. V. Breen. Agr. and Food Chem. 2: 618-623. 1954.

The effects of anionic and nonionic types of surface active agents on the reaction phenomena during the acidulation of phosphate rock were studied in the laboratory to obtain information on their influence in industrial practice. The surfactants tended to accelerate the primary reaction between phosphate rock and sulfuric acid, but had no significant effect on

the extent of the overall reaction from 1 to 24 hours after mixing. The physical character of the product denned 20 hours at 70°C. was altered in varying degrees depending upon the type and chemical composition of the surfactant, the type of rock and the method of ore dressing used in its production, and the type of superphosphate produced. Results from this study indicate the need for a comprehensive examination of the problem of surfactant use in fertilizer technology.

SOME OBSERVATIONS ON THE REDUCTION OF 2, 3, 5-TRIPHENYLTETRAZOLIUM CHLORIDE IN PLANT TISSUE AS INFLUENCED BY MINERAL NUTRITION

By J. C. Brown. *Plant Physiol.* 29: 104-107. 1954.

Copper deficiency retards the development of reproductive organs of corn, wheat, and cocklebur. The dye 2, 3, 5-triphenyltetrazolium chloride was only weakly reduced in the copper-deficient plants. Maximum reduction of TTC was obtained in plants grown on a naturally calcareous soil or an organic soil to which copper was added.

Comparative ascorbic acid oxidase activity, catalase activity, and the concentration of copper and iron in corn and wheat showed that the reduction of 2, 3, 5-triphenyltetrazolium chloride in these plants could best be correlated with copper than with iron nutrition.

ESTIMATION OF AVAILABLE PHOSPHORUS IN SOILS BY EXTRACTION WITH SODIUM BICARBONATE

By S. R. Olsen, C. V. Cole, F. S. Watanabe, and L. A. Dean. *U. S. Dept. Agr. Cir.* 939. 1954.

A new method for extracting soil phosphorus with 0.5 molar solutions of NaHCO_3 at pH 8.5 is described. The method is adaptable to rapid, routine soil-testing procedures. A theoretical basis for development of the method is described. The extraction mechanism is based on the increased solubility of calcium phosphates as a result of lowering the Ca^{++} activity in solution. Also, the NaHCO_3 extracts about one-half of the amount of phosphorus on the surface of soil particles, which readily exchanges with P^{32} in the soil so-

lution. Secondary precipitation and absorption reactions are greatly minimized in the NaHCO_3 extractions.

THE EFFECT OF APPLICATION RATES OF NITROGEN, PHOSPHORUS, AND POTASH ON SOME CHEMICAL CONSTITUENTS IN TWO VARIETIES OF HOPS

By K. R. Keller and R. A. Magee. *Agron. Jour.* 46: 388-391. 1954.

Repeated annual applications of nitrogen, phosphorus, and potash were made during 1952 and 1953 on a planting in each of the varieties of hops, Fuggles and Late Clustels. The design of the experiment was a 3 x 2 x 3 factorial with 4 replications. Yields were recorded as harvest weight in pounds per plot and analyzed for their response to the various rates of nitrogen, phosphorus, and potash. The results from the analyses of the data for the two varieties indicated that significant increases in yields were due to the application of 100 pounds of nitrogen either alone or in combination with 100 pounds of P_2O_5 , or 150 or 300 pounds of K_2O .

EFFECT OF PHOSPHATE FERTILIZERS ON ZINC NUTRITION OF FIELD BEANS

By L. C. Boawn, F. G. Viets, Jr. and C. L. Crawford. *Soil Sci.* 78: 1-7. 1954.

In several experiments to determine whether high levels of phosphate in the soil were a contributing factor to the occurrence of zinc deficiency in beans in central Washington, phosphate applications had no effect on the uptake of either applied zinc or native soil zinc. More than doubling the concentration of phosphate in the plant tissue failed to produce zinc-deficiency symptoms or reduce the yield of dry matter of beans grown in greenhouse pots.

CALCULATION OF AMOUNT OF FERTILIZER FOR LAWNS

By J. E. Garton. *Okla. Agr. Expt. Sta. MP-38.* 1954.

An easy method of making calculations involved in lawn fertilization is presented. Using this graph will require breaking the lawn down into a number of rectangular plots, or calculating on the basis of lot size with allowances for the area occupied by the house.

CALIBRATION CHART FOR 10-FOOT FERTILIZER SPREADER

By J. E. Garton. Okla. Agr. Expt. Sta. MP-40. 1954.

An easy method of calibrating a 10-foot fertilizer spreader so it will spread specific amounts of fertilizer is presented. The only equipment needed is a straightedge and a sharp pencil. A farmer would like to put 250 pounds of fertilizer per acre on a square 40 acres, using a 10-foot spreader. He puts 300 pounds of fertilizer in the spreader and drives back and forth until he runs out of fertilizer. When he runs out, he finds that he has made 4 troughs (5,280 ft.) and has gone an additional 220 feet making a total of 5,500 feet. He locates 300 pounds of fertilizer on scale 1 and 5,500 feet on scale 2. He draws a straight line through these two points and extends it to scale 3 where he reads that he is putting on 238 pounds per acre.

CALCULATION OF FERTILIZER APPLICATIONS BY SPRINKLER IRRIGATION

By J. E. Garton. Okla. Agr. Expt. Sta. MP-41. 1954.

An easy method of calculating the amount of fertilizer to inject per set when fertilizing with a sprinkler system is presented. To use the graph, the information needed is the spacing between the lateral sets, the length of the area irrigated per lateral set, and the desired rate of fertilizer application per acre.

CALCULATION OF POUNDS OF FERTILIZER PER ACRE FOR DIFFERENT CONCENTRATIONS

By J. E. Garton. Okla. Agr. Expt. Sta. MP-35. 1954.

Here is presented a rapid and easy method of making some common fertilizer calculations. The only equipment needed is a straightedge and a pencil with a sharp point. To calculate the pounds of fertilizer to apply per acre, it is necessary to know two things--the pounds of nutrient element (nitrogen, phosphoric acid, or potash) required per acre and the percent of the nutrient element in the fertilizer. The pounds of nutrient element required per acre should be based on a soils analysis.

The percent of nutrient element in the fertilizer will be listed on the bag.

CALCULATION OF COMPARATIVE COST PER UNIT OF NUTRIENT ELEMENT FROM DIFFERENT FERTILIZERS

By J. E. Garton. Okla. Agr. Expt. Sta. MP-36. 1954.

An easy and rapid method of comparing fertilizers on the basis of cost per unit of nutrient element in the fertilizer is presented. To calculate the cost per pound of nutrient element, it is necessary to know the cost per ton (or per pound) of the fertilizer to be used and the percent of nutrient element in the fertilizer.

CALCULATION OF AMOUNT OF NITROGEN FERTILIZERS FOR TREES

By J. E. Garton. Okla. Agr. Expt. Sta. MP-39. 1954.

Presented here is an easy method of calculating fertilizer needs based on tree size and considering different concentrations. It requires the use of a tape measure, a straightedge, and a sharp pencil. To calculate the pounds of fertilizer, per tree, using this graph, it is necessary to know the percent of nitrogen in the fertilizer, the amount of nitrogen needed per square foot of trunk area, and the circumference of the tree trunk.

CALCULATION OF AMOUNT OF FERTILIZER PER ROW, FOR GARDENS

By J. E. Garton. Okla. Agr. Expt. Sta. MP-37. 1954.

Here is an easy method of figuring fertilizer requirements on a row basis. Equipment needed is a good straightedge and a sharp pencil. To use the graph, it is necessary to know the row spacing, row length, and the pounds of fertilizer per acre to be put on.

WHEAT YIELD AND USE OF MOISTURE ON SUBSTATIONS IN SOUTHERN SASKATCHEWAN

By W. J. Staple and J. J. Lehane. Canad. Jour. Agr. Sci. 34: 460-468. 1954.

Twelve years' data on the use of moisture by wheat crops at 7 experiment sub-

stations were summarized. The linear regression of yield on evapotranspiration showed an increase of 3.5 bushels per acre for each additional inch of water used by the crop. The relation was actually curvilinear so for high evapotranspiration the increase per inch was approximately 6 bushels per acre. These increases resulted not only from the direct benefits of moisture availability, but also from all factors associated with evapotranspiration that were favorable to the crop.

The estimate of yield on the substations was significantly improved when rainfall and stored moisture were used as separate variables. The regression coefficient for rainfall was 1.5 times that for stored moisture. This ratio was greater than that from long-time tank and field experiments at Swift Current.

Yields of wheat on fallow were not as highly correlated with total (24-month) precipitation as with evapotranspiration because of variability in moisture storage during the 21-month summerfallow.

SOIL AND PLANT ANALYSIS AS MEANS OF DIAGNOSING BORON DEFICIENCY IN ALFALFA IN QUEBEC

By G. J. Ouellette and R. O. Lachance. *Canad. Jour. Agr. Sci.* 34: 494-495. 1954.

Boron deficiency was found in 119 of the 266 alfalfa fields surveyed in Quebec from 1950 to 1953, inclusive. Of that number, 61 percent were located on light-textured soils, 45 percent on medium, and 14 percent on heavy. The critical level of boron in alfalfa, below which the foliage was abnormal, was 15 parts per million. Plant-tissue analysis afforded a more reliable criterion than soil analysis for the purpose of determining whether or not alfalfa was adequately supplied with boron. However, if provision is made for more boron in heavy than in sandy soils to avoid a deficiency of that element, soil analysis becomes a rather dependable indication of the boron status of a field. This work indicates that the heavy soils of Quebec should contain approximately 0.8 pound per acre of water-soluble boron and the sandy soils approximately 0.5 to support normal alfalfa. The data obtained by analyzing alfalfa plants grown in sand cultures containing various concentrations of boron and those obtained by analyzing the samples collected in the field, as related to the occurrence of deficiency symptoms, are in good agreement.

Structure Control

ASPECTS OF STRUCTURE THAT AFFECT GERMINATION IN A SILT LOAM SOIL

By C. S. Slater and A. Rodriguez (Grandas). *Soil Sci. Soc. Amer. Proc.* 18: 219-231. 1954.

Stability of aggregates to slaking, as determined by wet-sieve analysis, failed to account for differences in structural quality between naturally stable and chemically stabilized Christiana silt loam. The treated and untreated soils were equally resistant to slaking, but permeability and seed germination were better in the treated soil. These differences were related to differences in the consistency of the moist aggregates.

CAPILLARY INTAKE RATE OF WATER AND SOIL STRUCTURE

By D. Swartzendruber, M. F. DeBoodt, and D. Kirkham. *Soil Sci. Soc. Amer. Proc.* 18: 1-7. 1954.

Rate of capillary absorption of water in soils was measured and compared with some other physical measurements as a possible index of structure. Disturbed and undisturbed samples were used. The disturbed samples were treated in two ways. Part were incubated in the presence of moisture and nutrient solution; part were mixed with a synthetic conditioner. After the disturbed samples were treated, they were air-dried and screened to the size range 0.25-2.00 mm. Only this range of aggregate sizes was used in subsequent determinations. The undisturbed samples were cubes, 1 inch on an edge, sawed from larger, air-dry clods, taken originally from moist, but not wet soil profiles, some in good structure, some in poor.

For soils containing variable amounts and kinds of organic matter the capillary-intake rate is not a reliable index of structure; but for soils containing constant amounts and kinds of organic matter the capillary-intake rate should be satisfactory. An idealized capillary tube model of soil is presented as an aid in interpreting results. The model shows that with a constant wetting angle, the capillary-absorption rate should be an index of structure. But the same model shows

hydraulic conductivity should be a better index than the capillary-absorption rate. The last statement is in agreement with the experiments.

PROPERTIES OF SOIL AGGREGATES: I. RELATION TO SIZE, WATER STABILITY AND MECHANICAL COMPOSITION

By C. L. Garey. Soil Sci. Soc. Amer. Proc. 18: 16-18. 1954.

Material from three different soils in Arkansas was sieved through a series of standard screens and material collected in two forms: (1) by dry screening, and (2) by wet screening in water. Mechanical analysis, exchange capacity, and organic matter were determined for the water-stable aggregates for each of the sizes separated and related to the same properties of the whole soil.

Results indicate that the properties of the individual water-stable aggregates are somewhat different from those of the whole soil. The smaller aggregates of 0.15-0.42 in diameter tend to contain a larger content of clay and organic matter than do the large aggregates or the whole soil. Also the aggregates larger than 0.42 mm. possess lower exchange capacities than does the whole soil. A shielding of the effect of clay inside aggregates is indicated by the lack of uniform ratio of clay to cation-exchange capacity. This ratio is generally larger in the aggregates than in the whole soil.

EFFECT OF PREWETTING AND INCUBATION OF SOIL ON AGGREGATE ANALYSIS

By D. D. Evans. Soil Sci. Soc. Amer. Proc. 18: 10-12. 1954.

Data are presented for the water stability of air-dry, stored, field soil aggregates as influenced by prewetting treatments made respectively 24 hours and 5 minutes prior to wet-sieve analysis. Wetting the samples to moisture equivalent 24 hours prior to wet sieving, and then incubation, increased the water stability of samples significantly over samples wetted to the same moisture percentage 5 minutes before wet sieving. The prewetting treatments, when applied to soils from plots in two crop-rotation experiments, placed the

soils from the various rotations in different order of water stability, depending on whether the 24-hour or 5-minute prewetting period was used. As an extreme example, the 24-hour prewetting period resulted in the highest water stability for soil from a corn-oats rotation, whereas the soil from this same rotation, when prewetted for only a 5-minute interval, resulted in the lowest water stability of the several rotations.

The cause of the increase in aggregation by the two methods was investigated by superimposing a number of additional treatments on the basis wetting treatments. It was found that microbial activity during the 24-hour wet incubation period contributed very little to the increase. The increase was attributed to the hydration of the clay particles with a resulting removal of planes of weakness in the dried aggregates. It is suggested in field studies that a prewetting treatment be chosen which reinstates the soil to a structural condition that most likely exists, at a time, when the particular physical property of interest of the soils is of concern.

GREENHOUSE PLANT RESPONSE TO VINYL ACETATE-MALEIC ACID COPOLYMER IN NATURAL SOILS AND IN PREPARED SOILS CONTAINING HIGH PERCENTAGES OF SODIUM OR POTASSIUM

By J. P. Martin and W. W. Jones. Soil Sci. 78: 317-324. 1954.

The effect of vinyl acetate-maleic acid copolymer (VAMA) on growth of various plants in poorly aggregated soil, in soil with good physical properties, and in soil containing high exchangeable Na and K percentages was studied. Treatment of Ramona sandy loam significantly increased growth of carrot roots, and doubled growth of avocado seedlings but did not affect tomato plants, red beets, or orange seedlings. VAMA treatment of San Joaquin loam, a poorly aggregated soil, nearly doubled the growth of avocado seedlings but had no significant effect in Yolo sandy loam, a well-aggregated soil. Addition of VAMA to three old citrus soils in which orange seedlings grew very poorly did not appreciably affect growth of sweet orange seedlings.

SOME PHYSICAL FACTS ABOUT CONNECTICUT SOILS

By C. L. W. Swanson. Jour. Soil and Water Conserv. 9: 132-137. 1954.

For a long time scientists have looked at the soil from a chemical point of view. Perhaps this is understandable. Chemically some of the soils are loaded with fertilizer nutrients but physically they are at a low ebb. Farmers began to report that additional fertilizers did not do any good. Soil scientists tried chemical means of research and found that this did not answer the problem. Then some soil physicists began some probings. Many times it was quite easy to show that improved structure would increase production. With this small beginning, interest has grown until now in the Northeast the principal cooperative of the Northeastern Soil Research Committee is one dealing with soil structure. Conservation and good soil structure go hand in hand. With increased knowledge from research on how to improve structure we can expect better conservation of our soils.

EFFECTS OF CORNCOB MULCHES AND INCORPORATE SOIL MIXTURES ON PHYSICAL AND CHEMICAL PROPERTIES OF THE SOIL

By W. J. Carpenter and D. P. Watson. Soil Sci. 78: 225-229. 1954.

Immediately after application of freshly ground corncobs as either surface mulches or soil mixtures, a large reduction occurred in the nitrate concentration in the soil. The data from the aeration study indicated that the oxygen content of the soil air was very low at this time, possibly because of the respiration of microorganisms. Growth measurements revealed that plants in the mulch treatments made less new growth during the first few months after application of the fresh corncobs than did plants in the other treatments.

The aeration study indicated that although the percentage of aggregation, average diameter of the aggregates, and total porosity were increased in a soil beneath a surface mulch of ground corncobs, the percentage of oxygen in the soil atmosphere was less than the oxygen content of the soil of the nonmulch treatments.

Drainage

CHANGES IN DRAINAGE PROPERTIES OF A MUCK SOIL AS A RESULT OF DRAINAGE PRACTICES

By H. A. Jongedyk, R. B. Hickok, and I. D. Mayer. Soil Sci. Soc. Amer. Proc. 18: 72-76. 1954.

Investigations of physical properties of muck soils using core samples, field observations of structure, and drawdown studies showed the drainage characteristics of organic soils may be changed as a result of drainage practices. Studies were conducted on tilled drainage plots at the Northern Indiana Muck Experiment Farm at Walkerton, Ind. Average water-table depths of 1.3, 2.1, and 3.3 feet were maintained from 1944 through 1950.

Significant changes have occurred in depth of soil, horizontal and vertical permeability rates, pore-space distribution, and soil structural characteristics in the soil of the deeper drained plots (2.1 to 3.3 feet deep water tables) compared with shallow drained plots which may be considered as checks. Soils with very high permeability rates and desirable structural characteristics, favorable to crop growth and easy water control, exist on plot areas which had the deeper water tables. High water-table plots have had more peaty muck soil with blocky, spongy structure and low effective permeability rates. Increased decomposition of soil, root growth, and earthworm activity occurred with lower water tables. Some practical aspects of the changes in soil properties are presented.

THE SHORT METHOD OF SURVEYING FOR SMALL OPEN DITCHES

By G. S. Vasilakes. Agr. Engin. 35: 644-645. 1954.

A "short-method" of surveying for small open ditches was developed by the Soil Conservation Service. The level-man easily learns to judge when to change the ditch grade in response to the changing conditions. As it allows him to do all his calculations in the field, he can start surveying just ahead of the constructor--and remain ahead.

SEEPAGE OF ARTESIAN AND SURFACE WATER INTO DRAIN TUBES IN STRATIFIED SOIL

By D. Kirkham. Amer. Geophys. Union Trans. 35: 775-790. 1954.

The problem of the simultaneous upward seepage of water from an artesian basin, and downward seepage of water from a ponded surface source into drain tubes, is analyzed for a soil consisting of two horizontally stratified layers, each of different, but uniform permeability, overlying the artesian gravel. Theoretical formulas for the hydraulic head, the drain flow, and the surface-inflow distribution are obtained for: (1) The drains in the upper layer, and (2) the drains in the lower layer. Flow nets are presented and compared with some obtained by other investigators in sand-tank models. The agreement is satisfactory.

INFILTRATION AND AVAILABLE WATER STORAGE CAPACITY IN THE SOIL

By K. G. Reinhart and R. E. Taylor. Amer. Geophys. Union Trans. 35: 791-795. 1954.

Results of studies at Vicksburg, Miss., have emphasized the importance of antecedent available storage capacity upon infiltration rates and amounts for certain fine-textured soils. The recovery of infiltration rates after cessation of rainfall was slow because of a corresponding slow rate of recovery of available storage. The value of electrical-resistance units, to follow the downward movement of water during infiltration runs and to determine the rate at which storage capacity became available after runs, was demonstrated.

SOME NOTES ON THE RELATION OF GROUND-WATER LEVELS TO POND LEVELS IN LIMESTONE SINKS OF SOUTHWESTERN GEORGIA

By E. L. Hendricks. Amer. Geophys. Union Trans. 35: 796-804. 1954.

Records of water levels in limesink ponds in southwestern Georgia and of water-table levels in the vicinity of these ponds are used to demonstrate: (1) Some ponds with highly impermeable beds are virtually unaffected by water-table levels, except when water-table levels are above

the rim of the impervious materials; (2) interchange of water between pond and water-table occurs when beds are relatively permeable. Three phases in the relation between pond level and water-table level are recognized: (1) water-table level higher than pond level causing ground-water level below pond level but in direct contact with it and measurably controlling rate of seepage from the pond; (2) ground-water level below pond level but not in direct contact with it and not appreciably controlling rate of seepage from the pond; (3) ground-water level below pond level but not in direct contact with it and not appreciably controlling rate of seepage from pond. In phase (3) the water table has a perceptible mound at a point underneath the pond.

Irrigation

CHANGES IN COMPOSITION OF IRRIGATED SOILS AS RELATED TO THE QUALITY OF IRRIGATION WATERS

By D. W. Thorne and J. P. Thorne. Soil Sci. Soc. Amer. Proc. 18: 92-97. 1954.

These studies were conducted to determine the effects of field application of waters of different quality on the chemical composition of soils. Soil samples were obtained from paired sites within irrigated and unirrigated soil areas located in 14 different soil locations and representing use of 12 different irrigation waters. The data for irrigation water and soil composition were statistically analyzed for regression and correlation relations.

The salt content of the soils was found to be closely related to the salt content of the irrigation waters. The data did not indicate that the carbonates and bicarbonates in irrigation waters studied contributed significantly to either the accumulation of carbonates in soils or to increase in exchangeable sodium percentages.

CHANGES IN ORGANIC MATTER AND CERTAIN OTHER SOIL CONSTITUENTS IN FORTY YEARS OF CROPPING UNDER IRRIGATION

By R. F. Bishop and H. J. Atkinson. Canad. Jour. Agr. Sci. 34: 177-180. 1954.

In 1911, a 10-year rotation, including 6 years of alfalfa, was laid down under irrigation at Lethbridge, Alberta. Soil samples were taken at the beginning of the experi-

ment and again in 1922, 1940, and 1951. During the 40 years the soil has become more alkaline but no significant changes occurred in respect to the phosphorus and potassium status of the soil. There have been significant increases in total nitrogen and organic-matter content. In terms of the 1911 values, the nitrogen increased by 7.0 percent and the organic matter by 10.5 percent in the surface 6 inches. At the 6- to 12-inch depth, the increases were 42.5 and 45.2 percent, respectively.

SPRINKLER IRRIGATION OF COTTON AT COLLEGE STATION, 1953

By R. C. Garrett and S. T. Russell. Tex. Agr. Expt. Sta. Prog. Rpt. 1641. 1954.

The results obtained from this preliminary experiment indicate that a maximum cotton yield is obtained under relatively high moisture conditions. High moisture conditions result in a slight retarding of maturity, larger bolls, and longer staple length. The maximum demand for moisture began with flowering and increased until most of the bolls were mature.

EFFECT OF BICARBONATE ON SUITABILITY OF WATER FOR IRRIGATION

By L. V. Wilcox, G. Y. Blair, and C. A. Bower. Soil Sci. 77: 259-266. 1954.

The probable effects of long use of irrigation waters having variable total and relative concentrations of bicarbonate were investigated by intensive cropping of pots of Hanford sandy loam in the greenhouse. Exchangeable sodium-percentage determinations made after the soil had been irrigated as many as 86 times show that water containing more than 2.5 me./l. of "residual Na_2CO_3 " (defined as $(\text{CO}_3^{--} + \text{HCO}_3^-) - (\text{Ca}^{++} + \text{Mg}^{++})$) are not suitable for irrigation over a long period without use of amendments, that those containing between 1.25 and 2.5 me./l. are marginal, and that those containing less than 1.25 me./l. are probably safe. Accumulation of exchangeable sodium was significantly greater under low-leaching regime than under a high-leaching regime for waters having "residual Na_2CO_3 " contents in excess of 2.5 me./l., but was unaffected by the CaCO_3 content of the soil.

INTRODUCING FERTILIZER SOLUTIONS INTO HIGH-PRESSURE IRRIGATION SYSTEMS

By E. R. Allred and J. H. Pomroy. Agr. Engin. 35: 171-172. 1954.

Laboratory and field tests were made of a relatively simple and inexpensive method of introducing fertilizer solutions into high-pressure lines. The equipment consists of a water-pressure tank, sufficient galvanized iron pipe to extend between two riser pipe openings in the main line, three small regulating valves, and other miscellaneous pipe fittings. The total cost of this equipment is small with the tank being the only major item of expense.

The method operates on the basic hydraulic principle of continuity of flow. This principle merely states that in the case of flow through two parallel pipelines the sum of the flow through both branches equals the total flow through the main.

THE SOUTHEAST LOOKS AT SUPPLEMENTAL IRRIGATION

By J. R. Carreker. What's New in Crops and Soils. 6(8): 16-17. 1954.

Supplemental irrigation offers a means of balancing moisture distribution throughout the crop-growing season. It enables farmers to get full benefits from fertilizers applied. Thus, it results in higher yields, better quality, and closer control on dates of crop maturity.

At the Middle Tennessee Experiment Station at Columbia from 1945 through 1948, a 43-percent increase in milk worth \$61.30 per acre per year was obtained from an irrigated pasture, in comparison with a similar pasture not irrigated.

In Georgia, corn-yield increases resulting from irrigation ranged from 2.3 bushels per acre in 1948 to 59.5 bushels in 1952. They averaged 24.7 bushels per acre for 1946-53. Yield increase for tomatoes due to irrigation was 49.1 percent in 1951, 193.2 percent in 1952, and 97.9 percent in 1953. The yield on the irrigated plot was 18,915 pounds in 1952. Substantial increases in yields of cotton were also had from irrigated plots during 1949-53.

IRRIGATION OF SUGAR BEETS

By W. E. Larson. Mont. Agr. Expt. Sta. Cir. 205. 1954.

Plots irrigated when 54 and 66 percent of the available moisture had been removed produced yields of 22.9 and 23.5 tons per acre respectively. The sugar beets were irrigated an average of every 8 and 13 days for the 7 and 4 irrigation treatments, respectively. A third plot receiving no irrigation yielded 20.1 tons per acre. Undoubtedly the deep subsoil moisture was very effective in supplying moisture to the crop and partially accounts for the excellent yields produced without irrigation. The very high storage capacity of the soil (3.1 inches of water per foot of soil depth) also aided in keeping moisture available. This was particularly true during the early part of the season. Soil-moisture treatments have had no consistent effect on the sugar percentage in sugar beets. Apparently the sugar content is more related to other factors, particularly, nitrogen, than to moisture alone.

THE APPLICATION OF THE RING INFILTROMETER TO DIAGNOSIS OF IRRIGATION PROBLEMS IN SOUTHERN CALIFORNIA

By V. S. Aronovici. Amer. Geophys. Union Trans. 35: 813-820. 1954.

A study was made of the merits of 1-square-foot ring infiltrometers as a diagnostic tool in evaluating furrow irrigation in citrus orchards of southern California. The results indicate that this device is not suited to quantitative evaluation of irrigation-furrow performance but does provide qualitative values, which have use in the study of diversified soil conditions influencing irrigation-furrow performance.

The forces involved in the movement of water into the soil from furrows include both gravity and suction head. These forces are difficult to evaluate and impossible to duplicate with a conventional ring infiltrometer. Ring infiltrometers, alone, do not provide sufficient information on the character of the soil profile to evaluate adequately irrigation problems in citrus orchards.

Erosion control

EFFECTIVENESS OF COVER IN REDUCING SOIL SPLASH BY RAINDROP IMPACT

By B. Osborn. Jour. Soil and Water Conserv. 9: 70-76. 1954.

Measurements of soil erosion by splash under different kinds and amounts of range and crop land cover showed effective control of erosion is possible on all soils and indicate the amounts of cover required for different degrees of protection.

Effectiveness of cover in preventing erosion is proportional to the amount present to intercept the energy of the raindrop before it strikes the soil. Both degree of surface coverage and weight per acre are satisfactory measures of the amount of cover, but the best indication of effectiveness is obtained by combining coverage and weight into an index of "effective weight."

Curves expressing the erosion control values of cover in relation to amount are presented. These show that for effective (95 percent) control of raindrop energies, approximately 2,000 pounds per acre of short sod grasses, 3,500 pounds of ordinary crops or grasses, or 6,000 pounds of tall coarse crops and weeds are required. Soil protective values decline rapidly as the amount of cover is reduced below these levels. Under field conditions, cover exercises the controlling influence on erosion by raindrop impact during hard rains. On every soil tested, maximum amounts of all kinds of both range and crop cover held detachment and movement of soil to a very small fraction of the potential, regardless of the character of the soil itself. The manner in which forage and crops are harvested and their residues are managed profoundly influences the soil-protective value of the cover.

SOME OBSERVATIONS ON SOIL EROSION IN THE MIDDLE AND EASTERN MEDITERRANEAN AREA

By M. R. Huberty. Amer. Geophys. Union Trans. 35: 244-246. 1954.

The question is raised whether soil erosion has ever been a serious problem on the karstic formations in the Mediter-

ranean area. Some of the soil and water conservation practices of the Romans are described, as well as the present practices and organizations in several countries in the middle and eastern Mediterranean region.

EROSION IN THE SAN GABRIEL MOUNTAINS OF CALIFORNIA

By J. D. Sinclair. Amer. Geophys. Union Trans. 35: 264-268. 1954.

Natural features of topography, geology, soil, and climate in the San Gabriel Mountains are all conducive to high rates of erosion. When the vegetation on steep slopes is removed as by fire, or the land surface is disturbed, erosion may be greatly accelerated through increased surface runoff. Flood flows bulked with debris have caused loss of life, sedimentation of reservoirs, and extensive property damage downstream. Removal of soil by erosion also adversely affects conditions on the mountain watersheds. Eroded material carried by flood runoff from the mountains greatly complicates problems of flood regulation and water conservation on valley lands below.

Solution of these problems has been sought mainly through protection of the vegetation on the mountains from fire and by construction of extensive engineering works, the latter mostly downstream. Studies are being made by the U. S. Forest Service on sources, processes and rates of erosion on the mountain slopes, and of means to increase the stability of soils by improving the vegetation on areas where erosion is most severe.

PIPING

By J. E. Fletcher, K. Harris, H. B. Peterson, and V. N. Chandler. Amer. Geophys. Union Trans. 35: 258-262. 1954.

Five conditions that must be present for erosion known as piping, where the subsoil erodes out from under the surface, to occur are: (1) There must be a source of water, (2) surface infiltration rate must exceed permeability rate of some subsoil layer, (3) there must be an erodible layer just above the retarding layer, (4) water above the retarding layer must have a hydraulic gradient to make it flow, and (5) there must be an outlet for the lateral flow.

RAINFALL INTENSITY AS A MEASURE OF STORM EROSIVITY

By P. C. Ekern. Soil Sci. Soc. Amer. Proc. 18: 212-216. 1954.

The erosivity of storms should be proportional to the additive kinetic energy from the impact of falling rain and shallow flow of water. The erosivity of shallow water should be proportional to the proximity of the maximum velocity thread to the soil surface and the square of that maximum velocity. Relations among velocity, slope, and discharge suggest the following function for erosivity:

$$\text{Erosivity} = f((\text{discharge rate})^{1.0} (\text{slope})^{1.0})$$

Evaluation of data suggested that the relation was reasonable, though a slightly higher value than the first power of the discharge was generally found.

When discharge in turn was related to rainfall intensity, the erosivity for shallow flow became:

$$\text{Erosivity} = f[(\text{storm intensity})^{1.46} (\text{slope})^{1.0}]$$

The impact energy of rainfall was found to be a nearly identical function of intensity and slope so that the additive energy of shallow flow and drop impact should approximate the 1.5 power of the storm intensity.

THE EFFECT OF CONSERVATION PRACTICES ON RUNOFF, AVAILABLE SOIL MOISTURE AND COTTON YIELD

By E. Burnett and C. E. Fisher. Soil Sci. Soc. Amer. Proc. 18: 216-218. 1954.

The mechanical conservation practices of contouring and terracing have produced significant differences in runoff, available soil moisture, and cotton yield in a 26-year experiment at Spur, Tex. The increased cotton yield may be attributed primarily to reduction or elimination of runoff with attendant deeper penetration of moisture which resulted in reduction of moisture losses by evaporation and weed growth.

Available soil moisture in the second and third feet of soil on May 20 was increased from an average of 1.27 inches on plots with rows in the direction of the slope to 1.60 inches on contoured plots with closed level terraces. The average annual

runoff on the former plots was 2.75 inches and was completely eliminated on the latter. The average yields of lint cotton for the two practices were 117 and 188 pounds per acre.

THE EFFECT OF RAINFALL, LAND SLOPE, AND CROPPING PRACTICES ON RUNOFF AND SOIL LOSS

By J. R. Carreker. Jour. Soil and Water Conserv. 9: 115-119. 1954.

Soil losses varied widely from year to year. Erosion on land planted to cotton continuously ranged from 51.34 tons per acre in 1943 to 5.33 tons per acre in 1950. The range in water losses was not so great, being from 19.29 inches in 1948 to 6.77 inches in 1951. The number of erosive rains each year affected the amount of either the rain or runoff.

Most of the erosion occurred in the spring and summer months because most of the erosive rains came then.

Runoff losses were increased to a small extent, and erosion to a very great degree, by increased land slope, even though the lengths of slopes for the 7- and 11-percent plots were only two-thirds and one-third the length of the 3-percent plots. Increased ground cover reduced both the runoff and erosion. As the slopes steepened, more ground cover was needed.

SEASONAL FLUCTUATIONS IN SOIL STRUCTURE AND ERODIBILITY OF SOIL BY WIND

By W. S. Chepil. Soil Sci. Soc. Amer. Proc. 18: 13-16. 1954.

The objective was to elucidate the effects of seasons on soil structure and erodibility by wind. Little change in soil structure and erodibility occurred during a mild, dry winter near Lubbock, Tex., in 1952-53, but considerable change occurred during several consecutive winters in some areas of the Prairie soil zone of Kansas where the soils were usually moist.

Under moist conditions, frost action tended to break down the coarse water-stable aggregates and at the same time tended to consolidate the finest fractions to an intermediate size, especially between 0.05 and 0.42 mm. in diameter. The probable mechanism of frost action on soil structure is described.

Secondary aggregates and clods tended to break down during the winter to a size erodible by wind (< 0.84 mm. in diameter). Often soil erodibility was higher in spring than in fall. The greatest increase in erodibility occurred in finest textured soils, the least in coarsest. Seasonal fluctuation in soil structure and erodibility seldom exceeded 3 inches in depth. Below this depth, the structure and erodibility changed little from season to season. During the summer there was usually an increase in the coarsest and the finest water-stable soil fractions. The finest water-stable fraction (< 0.02 mm.) contains materials essential for the building of primary and secondary soil aggregates.

THE WIND EROSION PROBLEM IN THE GREAT PLAINS

By A. W. Zingg. Amer. Geophys. Union Trans. 35: 252-258. 1954.

This summarizes briefly current knowledge and philosophies relative to the wind-erosion problem in the Great Plains area of the United States. The principal types of wind erosion experienced by the area are identified as "selective erosion" and "mass removal." Present and historical aspects of the problem are outlined. An equation expressing the regimen of soil removed by wind-tunnel tests for variations of vegetative cover on soils of different structure and surface roughness is presented. Climatic variation and chance occurrence of adverse combinations of climatic factors are cited as fundamental to the problem. The principles involved and methods used for abatement of the problem are discussed. The needs for climatic, soil, crop, tillage and erosion-control practice research for the development of adequate wind-erosion-control measures or practices are cited.

WATER EROSION PROBLEMS AND CONTROL ON NON-IRRIGATED AGRICULTURAL LANDS

By L. M. Glymph, Jr. Amer. Geophys. Union Trans. 35: 246-252. 1954.

The principal types of water erosion on nonirrigated agricultural lands are described. A generalized soil erosion map indicating extent and degree of erosion is presented. Selected summary data on rates of soil loss from 0.01-acre plots in

grasses, continuous row crops, and adapted crop rotations are given from nine experiment stations in important farming areas. Factors influencing rates of erosion are enumerated and discussed briefly. The objective of erosion control on agricultural lands is specified and some of the methods and principles of erosion control are listed.

KUDZU IN ROTATION WITH CORN AND SMALL GRAIN

By T. L. Copley and L. A. Forrest. N. C. Agr. Expt. Sta. Res. Rpt. 5. 1953.

A study of the use of corn and oats, or oats-grain sorghum in 3-year rotations with kudzu was conducted at the Soil Conservation Experiment Station, Raleigh, N. C. Three cropping systems and two levels of fertilization were used.

Corn and oat hay made excellent yields and the corn yields tended to increase as the experiment progressed. Kudzu recovered quickly following each interplanted crop, especially with heavier fertilization. Its recovery and survival appear related more to rate of fertilization than to amount of intercropping. The corn-oats-kudzu rotation provided almost complete soil protection, even during the corn-growing period, and such a rotation is well suited to cultivated land subject to severe erosion. Corn oats and kudzu appeared to be the most practical rotation of the three--from forage production as well as soil and water conservation. It is especially well adapted to a livestock system of farming since all crops in this rotation can be best harvested by grazing off with cattle and hogs.

INFLUENCES OF PINE AND GRASS ON SURFACE RUNOFF AND EROSION

By J. Kittredge. Jour. Soil and Water Conserv. 9: 179-185. 1954.

A comparison of surface runoff and erosion from undisturbed grassland and from a dense pine plantation over 13 years indicated marked differences in the surface runoff and close similarity in the small amount of erosion. The surface runoff from the pine litter in small amounts began usually when the seasonal rainfall was less than 1 inch whereas in the grassland, only after more than 5 inches. The total seasonal runoff from grassland was about five times that from the pine. Seasonal erosion from both types of cover averaged less

than 0.1 metric ton per acre, probably not more than the normal rate.

FACTORS THAT INFLUENCE CLOD STRUCTURE AND ERODIBILITY OF SOIL BY WIND: III. CALCIUM CARBONATE AND DECOMPOSED ORGANIC MATTER

By W. S. Chepil. Soil Sci. 77: 473-480. 1954.

On silt loam and sandy loam soils, 1- to 5-percent CaCO_3 caused a substantial disintegration of soil cloddiness, a decrease in mechanical stability of clods, and an increase in erodibility by wind. Additions of 0.3 and 10 percent had only a slight but variable effect on cloddiness and erodibility, according to the soil.

On loamy sand, the greater the amount of CaCO_3 added, the greater was the increase in soil cloddiness and mechanical stability of clods and the greater the decrease in erodibility by wind.

Addition of CaCO_3 alone to soil had little effect on the size distribution of water-stable aggregates. The effects of decomposed organic matter were similar to those of CaCO_3 , with one exception. Whereas CaCO_3 had little influence on the water-stable aggregates, decomposed organic matter increased somewhat the proportion of water-stable aggregates > 0.84 mm. in diameter and decreased appreciably the proportion of water-stable particles < 0.02 mm.

Decomposed organic matter increased the susceptibility of soils to wind erosion. Decomposed organic matter increased soil aggregation, but aggregation was limited, as a rule, to the formation of granules erodible by wind. These influences were amplified in soils containing a high proportion of CaCO_3 . The highest erodibility was recorded, consequently, for soils containing a high proportion of both CaCO_3 and decomposed organic matter.

Cropping systems

RESIDUAL PHOSPHORUS AVAILABILITY IN LONG-TIME ROTATIONS ON CALCAREOUS SOILS

By S. R. Olsen, F. S. Watanabe, H. R. Cosper, W. E. Larson, and L. B. Nelson. Soil Sci. 78: 141-151. 1954.

The availability of phosphate residues in three calcareous soils was evaluated

from A-value measurements. These soils from long-time rotations had received phosphate from manure or concentrated superphosphate. Highly significant correlations were found between A values and the percentage of maximum yield measured in greenhouse pots, and between A values and total phosphorus uptake by oats.

Four chemical extraction methods, Bray, NaHCO_3 , HOH , and surface phosphorus, were highly correlated with A values. Regression equations and the standard error of estimate are given for use in predicting A values from the chemical extraction methods.

The A-value measurements indicated that the relative efficiency of the phosphate residues compared to a freshly added resin-phosphate was 26 to 30 percent on Ft. Collins loam, 31 to 38 percent on Pryor silty clay for the manured plots, and 40 to 56 percent on Tripp very fine sandy loam.

The availability of phosphorus from the resin-phosphate was found to be similar to that from concentrated superphosphate. These differences between soils in the relative efficiency of the phosphate residues are not necessarily characteristic of the soil type. Some evidence indicates that the initial level of available phosphorus is an important factor affecting the relative efficiency of the phosphate residues.

Residue management

NITROGEN INTERCHANGE DURING DECOMPOSITION OF ORANGE AND AVOCADO TREE RESIDUES IN SOIL

By A. Wallace and R. L. Smith. Soil Sci. 78: 231-242. 1954.

Although avocado leaves under local field conditions are decomposed slowly in comparison with orange leaves, approximately half the organic matter of finely ground avocado leaves in soil was lost in about 100 days of incubation. Three fourths or more was lost at the same time with orange leaves. Simultaneously there was no nitrification with avocado leaves but considerable nitrate-N production as orange leaves decomposed, even though both residues had approximately the same nitrogen content. Added nitrate-N was incorporated at the same rate in soil when both orange and avocado leaves were being decomposed.

When no inorganic N was added, the N in plants coming from N labeled in organic residues was essentially equal to the actual

N increases in the plants. This means that the N becoming available to the plants did not come from the soil organic-matter fraction. When inorganic N was added with the organic residue, there was more labeled N in the crop than the actual increase in N that could be attributed to the added organic residue by the subtraction method. The organic residues resulted in reduced recovery of added nitrate-N by plants.

Tillage and cultural practices

EFFECT OF TILLAGE PRACTICES UPON INTAKE RATES, RUNOFF AND SOIL LOSSES OF DRY-FARMLAND SOILS

By C. H. Diebold. Soil Sci. Soc. Amer. Proc. 18: 88-91. 1954.

During the growing season, serious losses of water and soil occur on extensive areas of dry farmland in New Mexico, Colorado, and Utah due to poor surface soil condition and to the presence of tillage pans, usually at depths of from 3 to 8 inches. Studies were made of runoff and soil losses from plots containing 30-1/2 square feet. Simulated 10-year storms were applied to these plots to evaluate tillage practices. The following conclusions were made: Chiseling through the tillage pan every 12 inches reduced both soil and water loss more than cultivation with either sweeps or oneway disks on deep, medium textured soils. Excessive runoff and erosion occurred where the chisel spacing was 5 feet, or where chiseling, sweeps, and oneway did not penetrate through the tillage pan.

A STUDY OF THE USE OF SURFACE MULCH TILLAGE FOR CORN AND WHEAT IN NORTH CAROLINA

By T. L. Copley and L. A. Forest. N. C. Agr. Expt. Sta. and U. S. Dept. Agr. Agr. Res. Serv. Res. Rpt. 276. Apr. 1954.

This study was conducted to determine the effects of surface utilization of crop residues on yields of corn and wheat in different cropping systems and the mechanical problems involved in mulch tillage.

Mulch tillage of corn, following wheat-lespedeza resulted in lower corn yields than clean tillage; but in corn following winter cover of rye-vetch, there was little difference in yields between the two tillage methods.

Surface mulch with pre-emergence 2,4-D and only one lay-by cultivation resulted in as good corn yield as mulch with normal tillage or clean tillage. Weeds and grass tended to germinate more readily under mulch tillage than under clean tillage, and as a result, more prompt and careful cultivation was necessary for effective weed control.

SOME EFFECTS OF MULCH TILLAGE

By F. W. Schaller and D. D. Evans. Agr. Engin. 35: 731-734. 1954.

Soil tilth and aeration as factors affecting corn yields under mulch tillage appear to be important, but are difficult to measure and evaluate. In general, they vary in importance with soil type, seasonal conditions, and tillage technique. Fine-textured soils and soils with poor natural structure and inferior drainage and aeration give the most trouble. Cool, wet seasons accentuate aeration problems. Applications of fertilizer help to alleviate reduced availability of nitrogen and potassium under mulch tillage and increase corn yields. In some experiments when adequate fertility was present, corn yields under mulch tillage have been equal to those obtained with plowing. In other experiments this has not been true. This suggests that other unfavorable growth conditions were present, or that the amount and kind of fertilizer was inadequate, or that the placement of fertilizer was not right.

Equipment

A ROLLING COULTER FURROW OPENER FOR DEEP PLACEMENT OF FERTILIZER

By C. M. Hansen and R. E. Lucas. Mich. Agr. Expt. Sta. Quart. Bul. 36: 310-317. 1954.

Development work was started in 1953 on a furrow opener to simultaneously place one band of starter fertilizer 2 inches to the side and 2 inches or more below the seed; and, to place a second band 4 inches below the starter band. Plant nutrients applied at planting time at two levels below the corn seed yielded 3.8 bushels per acre more corn than equivalent amounts applied in two operations, one at planting time and one later as a sidedress. Corn fertilized with the rolling coultter opener out-yielded

corn fertilized in a single band by 2.5 bushels per acre.

Some additional horsepower is required to pull the planter equipped with the rolling coultter furrow openers as compared with conventional corn planters. The design of the rolling coultter opener makes it possible to apply different fertilizer simultaneously at two different levels. The use of a rolling coultter opener can eliminate the need for a sidedress application later in the season.

A SLIDE RULE FOR SOIL MOISTURE DETERMINATIONS

By E. F. Rowland, T. D. Fagan, and G. A. Crabb, Jr. Agr. Engin. 35: 163-164. 1954.

A special-purpose slide rule in one operation successfully corrects the observed electrical resistance of Bouyoucos-type plaster of Paris soil-moisture blocks for soil temperature variation and converts the corrected resistance readings to percentages of available soil moisture in soils with average salt contents. Formulas for the construction of this slide rule as well as the more generally used correctional nomograms are presented, along with pertinent design data and instructions.

NEW DEVELOPMENTS IN FERTILIZER MACHINERY

By C. E. Guelle. Agr. Engin. 35: 165-170. 1954.

Major developments in fertilizer machinery have been made necessary by the radical changes in available fertilizers and fertilizer materials. Some are discussed and illustrated.

THE JOHNSTON CHAIN DRAG FOR CLEARING BRUSH FROM RANGE LAND

By R. A. Lyman and W. E. Sykes. Jour. Range Mgt. 7: 31-32. 1954.

Studies involving the use of the chain drag for eradicating brush from rangeland were conducted in Hawaii. The results show that this is an effective and economical method of eradicating brush from some rangelands.

AN EXPERIMENTAL CULTIVATOR FOR ELIMINATING SOIL-SURFACE COMPACTION BY TRACTORS

By C. L. W. Swanson. Agron. Jour 46: 237-239. 1954.

An experimental cultivator constructed for the purpose of studying the effect of cultivation on crop growth and soil properties is described. It is used to compare standard cultivation with plots kept weed free without cultivation, or cultivated once with a tractor or with the experimental cultivator; and also with complete packing of the plots by additional tractor passes and packing with a hard tamper.

HIGH-SPEED ROTARY HOEING

By H. E. Rea. Tex. Agr. Expt. Sta. Prog. Rpt. 1691. 1954.

A rotary hoe has been designed and is described here. It can be operated at a speed of 18 miles an hour in cottonfields. One time over a cottonfield with the implement destroyed 65-70 percent of the weeds. A second rotary hoeing produced 85-90-percent control. Two rotary hoeings combined with a pre-emergence treatment of CIPC, at 8, 10, and 12 pounds per acre produced 95-98-percent control.

CROPS

General

BICARBONATE ION AND OXYGEN LEVEL AS RELATED TO CHLOROSIS

By W. L. Lindsay and D. W. Thorne. Soil Sci. 77: 271-279. 1954.

Greenhouse studies were made with nutrient solutions to determine the effect of different O₂ levels in the aeration mixture upon the chlorosis of plants grown in a bicarbonate medium. Great northern bean plants were grown in nutrient solutions to determine the effect of bicarbonate ion, oxygen tension, and iron source upon chlorosis.

Soil solutions from chlorotic areas had a higher concentration of bicarbonate and calcium ions than did those from adjacent green areas. Applications of either gypsum or sulfur to a calcareous soil increased soluble calcium and magnesium. These same treatments suppressed the concentra-

tion of bicarbonate in the soil solution at greater depths than 12 inches.

The bicarbonate ion reduced the movement of radio-iron into the leaves and stems and accentuated its accumulation in the roots. Chlorosis in bicarbonate-treated cultures increased at the high oxygen levels. This condition was accompanied by reduced movement of iron to the leaves, lower chlorophyll, and reduced growth.

These studies indicated that the increase of plant chlorosis frequently associated with poorly aerated conditions cannot be primarily attributed to a reduced oxygen level at the roots.

IMPORTANCE OF CLAY CONTACT FOR RICE CULTIVATION UNDER WATER-LOGGED CONDITIONS

By M. A. Islam and W. Islam. Soil Sci. 77: 267-270. 1954.

Three different types of soil were kept waterlogged for a long time, and then rice plants were grown in them. In some pots the plants were put directly in the clay and in others they were supported in the supernatant liquid without any contact with the clay. The plants in contact with the clay made normal growth and bore grain, whereas the plants in the supernatant liquid failed, thus showing that plants absorbed a large portion of their nutrients from the clay by contact. Soil analysis showed that as a result of waterlogging, NO₂-N disappeared, NH₄-N increased, and an insignificant quantity of nutrients remained in the supernatant liquid, the greater part remaining in the clay.

COMPARISON OF BAND SEEDING AND OTHER METHODS OF SEEDING LEGUMES

By M. B. Tesar, K. Lawton, and B. Kawin. Agron. Jour. 46: 189-194. 1954.

Nine field tests were conducted in Michigan to determine the efficiency of four different methods of seeding alfalfa and birdsfoot trefoil on three different soil types.

Twenty-two percent more seedlings were obtained when legume seed was banded on top of the ground directly over fertilizer drilled 1-1/2 inches deep in 7-inch rows than when the seed was broadcast on similarly fertilized soil. Band seeding also resulted in taller, more vigorous plants than were obtained from broadcast seeding.

Placing the legume seed in a band above but 1 inch away from the fertilizer resulted in more seedlings than band seeding in only one of six tests. This was with birdsfoot trefoil on a droughty loamy sand.

This difference was attributable to the fact that seedlings immediately above the fertilizer were able to use the fertilizer phosphorus much earlier than seedlings more remotely removed from the phosphorus.

THE EFFECT OF HERBICIDES ON THE DRYING RATE OF HAY CROPS

By W. K. Kennedy, W. H. Hesse, and C. M. Johnson. *Agron. Jour.* 46: 199-203. 1954.

The drying effect of translocated and contact herbicides on alfalfa, timothy-red clover, and soybeans was investigated in a series of experiments during the summers of 1951 and 1952. The effects of the herbicides on the whole plant and on the leaves and stems separately were studied. The result of treating these plants 24, 48 and 72 hours prior to cutting was also considered.

Dinitro-ortho-secondary-butylphenol and disodium 3, 6-endoxyhexahydrophthalate had the best forage drying properties of any of the herbicides tested. Application of the herbicides 24 or 28 hours prior to cutting was more satisfactory than cutting immediately after treatment.

SOIL ORGANIC MATTER, CROP YIELDS, AND LAND USE IN THE TEXAS BLACKLAND

By R. M. Smith, D. O. Thompson, J. W. Collier, and R. J. Hervey. *Soil Sci.* 77: 377-388. 1954.

During 70 years of cultivation, Blackland clay soils have lost 50 percent or more of their surface organic matter as well as large quantities from subsurface layers. On a desurfaced plot the buildup during 20 years of native vegetation has amounted to 600 pounds of organic matter or 30 pounds of N an acre annually.

Field plots on deep Blackland soil gave an average of 29 bushels of corn an acre for 20 years of continuous corn with no clear evidence of a downward trend with time. Organic matter was 2.5 percent in the surface and 2.2 percent in the subsurface 3 years after completion of this

continuous cropping. In three runoff-erosion plots the average corn yield through 20 consecutive years was 23 bushels an acre, with no clear yield trend during the last 10 years. At the end of the period, soil organic-matter levels were 2.0 percent in both the plow layer and the subsurface soil.

PLANT STUDIES WITH RADIOACTIVE CHLORINE

By S. J. Toth and A. E. Kretschmer. *Soil Sci.* 77: 293-302. 1954.

A method was developed for determining the relative concentrations of Cl36 in plant tissues, and distribution and movement of the isotope were studied in four plant species.

In tomatoes, the highest content of Cl36 was found in the stem and petiole portion below the lowest fruit cluster. In alfalfa, Cl36 apparently does not move rapidly into the mature reproductive regions. Upper portions of alfalfa contained more radiochlorine than did lower portions. Roots contained less Cl36 than did any other part of the plant except mature flowers.

In lima beans, the highest content of Cl36 was found in the main pulvani. The Cl36 content of bean seeds in the pod was related to the degree of maturity, the less mature containing the most Cl36. In corn, the middle third of the cob contained more Cl36 than did the upper or lower portions, whereas the highest Cl36 content of the grain was found near the ear tip. The edges had higher Cl36 content than did any other part of the leaf. Tomato, beet, wheat, and rye plants absorbed and translocated Cl36 applied to the foliage.

THE EFFECT OF P³² RADIATION ON CROP GROWTH AND PHOSPHORUS UPTAKE: I. GREENHOUSE STUDIES

By E. Penner. *Canad. Jour. Agr. Sci.* 34: 41-47. 1954.

Thatcher wheat was grown for 20-, 30-, and 40-day periods under greenhouse conditions. Radioactive NH₄H₂PO₄ (24 lb. P₂O₅ per acre) were applied in solution and in granular form at levels of P³² ranging from 0-3600 μ c P³² per gram P³¹. When applied in solution, radiation effects were shown to occur at levels as low as 12 μ c P³² per gram P³¹ causing alterations in plant weight and soil phosphorus absorp-

tion. No deviations occurred when radioactive $\text{NH}_4\text{H}_2\text{PO}_4$ was applied in granular form. A further experiment included several common cereal crops. Radioactive $\text{NH}_4\text{H}_2\text{PO}_4$ was applied in granular form at levels ranging from 0-4,000 μc P^{32} per gram P^{31} . Some reduction in soil phosphorus absorption occurred with oats and barley at 8 and 80 μc P^{32} per gram P^{31} , respectively. Wheat showed no variations in any of the criteria examined. No alterations in soil phosphorus, fertilizer phosphorus ratios occurred in any of the experiments.

Under greenhouse conditions, when the fertilizer is applied in granular form, changes in growth, or uptake of phosphorus in cereal crops due to radioactivity, do not appear to seriously affect the value of the tracer method.

RESEARCH ON RICE PRODUCTION IN TEXAS

By E. B. Reynolds. Tex. Agr. Expt. Sta. Bul. 775. 1954.

This bulletin reports some of the studies conducted on rice production by the Rice-Pasture Experiment Station, Beaumont, during the past 10 years. These include the development and testing of new and superior varieties of rice; time, methods, and rates of seeding; time, methods, and rates of application of fertilizers; studies on irrigation; control of weeds, insects and diseases; and drying and storing rough rice. Bluebonnet 50, Improved Bluebonnet, Century Patna, Texas Patna, and TP 49 are the more important varieties developed in the rice improvement program in Texas.

Experiments indicate that the optimum rate of seeding is about 90 pounds per acre. Applications of 80 pounds of nitrogen and 40 pounds of phosphoric acid per acre (80-40-0) gave better results than other fertilizers on Beaumont and Lake Charles clay and Lake Charles clay loam, and are recommended for these soils. The use of 40-40-20 is recommended for Katy fine sandy loam. Sulfate of ammonia, urea, and cyanamid were better sources of nitrogen for rice than nitrate of soda. The use of 45 to 50 inches of water for irrigation produced as large a yield of rice as larger amounts of water. Draining ricefields once during the season increased the yield of rice considerably.

Suitable cultural practices and the judicious use of water are at present the

most practical means of controlling both grasses and broadleaf weeds in ricefields. Summer or fall plowing, with several diskings timed to kill weed seedlings before planting rice, is a basic step in getting clean stands of rice. If cultural practices are not feasible, chemical control may be used. Formulations of 2,4-D or 2,4,5-T applied in accordance with State laws, can be used in the control of weeds.

CROP AND LIVESTOCK OPPORTUNITIES ON EASTERN OKLAHOMA PRAIRIE LAND FARMS

By W. F. Lagrone. Okla. Agr. Expt. Sta. and U. S. Dept. Agr., Agr. Res. Serv. Bul. No. B-430. 1954.

Considerable opportunity for increasing efficiency in producing crop and livestock enterprises through improvements in production practices exists on Prairie soils of eastern Oklahoma. Present research indicates practical possibilities of doubling per acre yields of cotton and feed crops. Legumes, sweetclover in particular, would be grown in rotation with row crops. Production of beef per acre of pastureland could be increased more than 100 percent over the present production level with an improved pasture program of seeding, liming, and fertilizing. As many present pastures have received some improvement, the increase in production above the level of unimproved pasture would be even greater.

An improved pasture and general management program on dairy farms could result in average annual milk production per cow of 6,000 pounds of 4-percent milk with a relatively low rate of concentrate feeding to milk produced (1 pound of concentrates to 4.6 pounds of milk).

COMPETITIVE UPTAKE BY PLANTS OF POTASSIUM, RUBIDIUM, CESIUM, AND CALCIUM, STRONTIUM, BARIUM FROM SOILS

By R. G. Menzel. Soil Sci. 77: 419-425. 1954.

Radioactive isotopes were used to follow the uptake by plants of trace quantities of the heavier alkali and alkali earth ions applied to soils. The uptake of strontium and barium was inversely proportional to the exchangeable soil calcium, and the uptake of rubidium and cesium was inversely proportional to the available soil potassium.

Distribution factors for uptake of the alkali ions were calculated as

$$\frac{\text{Percentage of applied ion taken up}}{\text{Percentage of available potassium taken up}}$$

For the alkaline earth ions the denominator was the percentage of exchangeable calcium taken up. Distribution factors were: rubidium, 1.0; cesium, 0.04; strontium, 0.4; and barium, 0.02.

Field Crops

EFFECT OF SPACING IN WINTER VERSUS SPRING GRAIN COMPANION CROPS AND ITS RELATION TO NITROGEN FERTILIZATION OF THE WINTER TYPE

By C. R. Blackmon and R. S. Snell. Agron. Jour. 46: 489-491. 1954.

The effect of three different drill-row spacing on the growth and yield of wheat as a companion crop was studied for two seasons both with and without nitrate top-dressing.

The alternate 7- and 14-inch spacing gave significantly higher grain and straw yields than either the 7- or 14-inch spacing although tillering was greatest with the 14-inch spacings. The number of red clover plants established was not significantly affected by the spacings used.

Application of 30 pounds of nitrogen per acre as a spring topdressing in the form of sodium nitrate significantly increased the yield of grain, the number of tillers, and the height of grain at all spacings. Nitrogen decreased the number of red clover plants and depressed the growth of the clover but not significantly,

FACTORS AFFECTING GERMINATION OF RUNNER PEANUTS

By J. H. Blackstone, H. S. Ward, Jr., J. L. Butt, I. F. Reed, and W. F. McCreery. Ala. Agr. Expt. Sta. Bul. 289. 1954.

This report covers four phases of research on factors affecting germination of runner peanuts. The germination of the 135 samples of peanuts, collected from individual farms in the 11 counties of the Peanut Belt, showed a high variation between farms and between areas. Indications were that peanuts of high viability could be produced within any county of the Peanut

Belt. No one geographic location that should be given preference for the production of runner peanuts for seed purposes could be delineated. Only small differences were in the percentage of germination of runner peanuts when related to type of soil on which they were produced. Consequently, caution should be used in giving preference to any particular soil type in the selection of runner peanuts for seed purposes.

Indications from this study were that runner peanuts for seed purposes could be sorted from commercial stocks advantageously at harvest time if based on the official grade of peanuts. Only peanuts grading above 65 percent-sound, mature kernels; or less than 5-percent shrivels; or 1 percent or less in damaged kernels should be saved for seed purposes when any one grade factor is used for sorting purposes.

Only peanuts of a low kernel moisture content in the fall should be held for seed purposes. Also, only peanuts containing 0.30 percent or less free fatty acids should be held for seed purposes.

WAUBAY AND DUPREE, TWO NEW OATS FOR SOUTH DAKOTA

By V. A. Dirks. S. Dak. Agr. Expt. Sta. Bul. 436. 1954.

Waubay and Dupree are two new oat varieties for South Dakota with a limited area of adaptation: Dupree for the central and western part of the State and Waubay for the eastern, especially the northeastern, section.

EXPERIMENTS IN HARVESTING AND PRESERVING ALFALFA FOR DAIRY CATTLE FEED

By J. B. Shepherd, H. G. Wiseman, R. E. Ely, C. G. Melin, W. J. Sweetman, C. H. Gordon, L. G. Schoenleber, R. E. Wagner, L. E. Campbell, and G. D. Roane. U. S. Dept. Agr. Tech. Bul. 1079. 1954.

This study was conducted to determine the relative merits of harvesting alfalfa as grass silage, farm-dried hay, and dehydrated hay. It extended over 5 years, 1945-49. There is a definite relation between the length of time the cut forage is left in the field and the loss of dry matter and forage constituents. Using harvesting methods which shorten the field-curing

period provide an effective means of increasing the yield, leafiness, carotene content, and quality of harvested alfalfa forage. Dehydration permits the harvesting of forage in a shorter period in the field and a shorter time from cutting to storage than other harvesting methods, and therefore, results in smaller losses of leaves, digestible nutrients, green color, and carotene.

Making silage ranks next in these respects followed by barn drying with heat, barn drying without heat, field curing during good weather, and field curing during rainy weather. Other pertinent findings are also reported.

CORRELATION OF PHOSPHORUS CONTENT OF ALFALFA WITH pH AND FORMS OF SOIL PHOSPHORUS

By D. L. Hallock and O. J. Attoe. Soil Sci. Soc. Amer. Proc. 18: 64-67. 1954.

A study was made of the availability to alfalfa of acid soluble and alkali soluble inorganic and organic soil phosphorus. Samples of both soil and alfalfa were taken from experimental plots and farm fields located on 8 soil types.

For the plot samples, the content of acid soluble soil phosphorus in 1948 and pH in 1949 were the variables most closely related to the phosphorus content of the alfalfa. Out of 22 samples of significant correlations of the phosphorus, 2 were with soil pH, 8 each with the acid soluble and alkali soluble inorganic forms, and 4 with the alkali soluble organic form.

When the silt loam soils were divided into two pH groups, those below 7.0 and those of 7.0 and above, the contents of acid soluble and alkali soluble inorganic phosphorus were the forms most closely (and about equally) correlated with the phosphorus content of the alfalfa for both groups.

CORRELATION OF SOIL MOISTURE AND COTTON YIELDS

By E. Burnett and C. E. Fisher. Soil Sci. Soc. Amer. Proc. 18: 127-129. 1954.

In a 22-year experiment, the correlation between the yield of lint cotton and available soil moisture at 3 sampling dates and 6 sampling depths was determined. The most significant correlation existed for the available moisture in the soil on May

20, the optimum date for planting cotton. The correlation between yield and soil moisture was slightly lower for determinations made on June 20, and much lower for those made on April 20. Eliminating the moisture content of the first foot of soil, which fluctuates greatly because of weed growth and evaporation, improved the relations on all dates. The relations were not improved by including the moisture in the fourth and fifth feet of soil--an indication that in most years the cotton plant obtains most of the water for growth from the second and third feet of soil. The importance of deep-moisture storage in cotton production under subhumid and semiarid conditions is discussed.

CORN ROOT PENETRATION IN MUSCATINE, ELLIOTT AND CISNE SOILS

By J. B. Fehrenbacher and H. J. Snider. Soil Sci. 77: 281-291. 1954.

Muscatine silt loam presented very few, if any, handicaps to corn-root penetration. A few roots were found at a depth of 7 feet.

Elliott silt loam was underlain at shallow depths (24-28 inches) by a calcareous silty clay loam, glacial till of high volume weight, poor structure, and consequent low aeration; all of which largely prevented corn-root penetration. The low native fertility level of Cisne silt loam was the greatest deterrent of this soil to corn-root penetration.

On Cisne, where sufficient amounts of plant-nutrient elements were added and legumes turned under corn roots were highly developed throughout the compact, slowly permeable claypan. The claypan had well-developed prismatic structure, which permitted corn roots to penetrate and also extend laterally along structure partical faces. The zone of most limited root branching was the most highly leached horizon, the A₂₋₂, which was very gray and which had well-developed platy structure.

INFLUENCE OF LEGUME AND FERTILIZER NITROGEN ON FORAGE PRODUCTION AND BOTANICAL COMPOSITION

By R. E. Wagner. Agron. Jour. 46: 167-171. 1954.

Field studies were conducted to compare total dry-matter yield, distribution of production, and botanical composition of

mixtures of orchardgrass-Ladino clover and tall fescue-Ladino clover with that of their individual components and bromegrass grown in pure stands with and without nitrogen. The mixtures were higher yielding than the pure seedings. They contained less weeds and were more uniformly productive through the season. Even though fertilized with as much as 160 pounds of nitrogen per acre annually, tall fescue was significantly less productive than tall fescue-Ladino clover. Likewise, orchardgrass fertilized at the 160-pound rate was less productive than orchardgrass-Ladino clover although the difference was not quite statistically significant. Bromegrass and Ladino clover each in pure stand were low in productivity and heavily infested with weeds.

MODIFICATION IN CHEMICAL PROPERTIES OF STRAW DURING DECOMPOSITION

By F. E. Broadbent, Soil Sci. Soc. Amer. Proc. 18: 165-169. 1954.

Oat-straw samples were allowed to decompose for periods ranging up to 15 months; changes in functional groups and chemical properties followed as a function of time. Carbon increased in the whole residues and decreased in the lignin fraction while hydrogen decreased in both. Selected demethylation occurred in the lignin but methoxyl content of the complete residues remained about constant. Carboxyl groups as determined by esterification increased progressively, accompanied by decreases in hydroxyl. Carboxyl in the lignin fraction was in good agreement with exchangeable hydrogen determined by an iodometric titration procedure in contrast to lack of agreement between corresponding values in the whole residues. Cation-exchange capacity of the straw residues and their lignin component increased as decomposition progressed.

ALFALFA-COTTON RELATIONSHIP AND LYGUS BUG CONTROL

By W. L. Owen, Jr. Tex. Agr. Expt. Sta. Prog. Rpt. 1666. 1954.

When alfalfa is grown in a cropping program, increased insect damage from lygus bugs may occur on nearby cotton. Management of the legume influences insect populations on nearby cotton. Alfalfa grown as a hay crop does not create an insect problem to cotton, but when alfalfa is

grown for seed production, lygus populations may develop, later migrate to cotton, and damage squares and bolls. When seed maturity was delayed in alfalfa until late in the season, lygusbug migration to cotton was delayed and allowed some fruit set in the cotton. When alfalfa seed are allowed to mature in early July, as occurred in 1953, lygus bug transfer to cotton may result in severe damage to the cotton fruit. Yields in cotton under observation were reduced more than 75 percent in 1953 by lygus bugs.

A field-scale experiment indicated 10 percent toxaphene dust was effective in controlling lygus on cotton. Three applications resulted in an increase in yield of 483 pounds of lint per-acre gain over untreated cotton. The value of this gain was \$154.64, and the cost of control was about \$7 per acre.

PHOSPHORUS UTILIZATION BY CORN AS AFFECTED BY PLACEMENT AND NITROGEN AND POTASSIUM IN FERTILIZATION

By W. K. Robertson, P. M. Smith, A. J. Ohlrogge, and D. M. Kinch. Soil Sci. 77: 219-226. 1954.

A fertilizer experiment with radio phosphorus was conducted to study the effects of placement and of nitrogen and potassium fertilization on phosphorus utilization by corn.

Nitrogen and potassium fertilization had a striking effect on fertilizer-phosphorus utilization which emphasizes the importance of these nutrients in phosphate studies. Placement of the nitrogen and potassium fertilizer in relation to the phosphatic band also influenced phosphorus uptake. The effect of depth and number of fertilizer bands is in line with reported work.

The uptake of fertilizer phosphorus from band-applied fertilizer rapidly diminished as the season progressed. Rate of application had only a slight effect on the decrease.

THE EFFECT OF DATE OF PLANTING AND CLIPPING ON OAT FORAGE AND GRAIN YIELDS

By L. V. Crowder. Agron. Jour. 46: 154-157. 1954.

Three autumn planting dates and four clipping treatments were studied to ascertain the effect of these variables on forage and grain yields of three oat varieties.

Arlington, Victoria, and Turf oats were sown in mid-August, mid-September, and mid-October. The four clipping treatments were (1) no clipping; (2) clipping in November and March; (3) clipping in November, March 1, and March 20; and (4) clipping in November, March 1, March 20, and April 15. Grain was harvested from all treatments.

Forage produced by oats sown in August and September could have been grazed in late October, while oats sown in October would not have furnished grazing until spring. Plant stands were superior and forage yields were higher following the September planting date as compared with the August date. Early sown Victoria oats were severely damaged by *Helminthosporium victoriae*; however, plant stands of the other varieties were also reduced, which indicated that other factors influenced germination and establishment of early sown oats. Fall and winter oat forage contained from 25- to 30 percent crude protein, but the protein content of spring forage dropped to 15 percent. Grain and straw yields were significantly lowered by clipping as compared with no clipping. Clipping after March 1 drastically lowered the grain yields; however, the value of forage obtained should compensate for the loss of grain.

PHOSPHORUS NEEDS OF SMALL GRAINS ON A MODERATELY SALINE SOIL

By L. O. Fine and P. L. Carson. Soil Sci. Soc. Amer. Proc. 18: 60-63. 1954.

An exploratory study was started in 1950 to evaluate soil amendatory practices which might be used to increase the yield of small grain on mildly saline intrazonal soils of the Chernozem area. Symptoms presently regarded as salt injury are widely observed on barley and oats and are associated with rather striking phosphate responses on the Maple soils. Application of large amounts of phosphate fertilizers, or manure and phosphate, in both the greenhouse and the field increased yields remarkably and alleviated symptoms on oats and barley. Phosphate application with the seed proved to be approximately twice as effective as broadcast applications.

Investigation of the soils revealed a higher total phosphorus content in the saline soil than in surrounding nonsaline soils. However, in sulfuric acid extractions of the saline smaller percentages and abso-

lute amounts of phosphorus were soluble than of the normal soil. In a greenhouse experiment using P^{32} on the saline and a normal upland soil, it was found that added sodium salts sharply depressed the yield, phosphorus uptake and percent plant phosphorus derived from the fertilizer, whereas added calcium salts only slightly depressed these. These observations appear to the authors to discount the theory that formation of salts of the nature of tricalcium phosphate is responsible for the low phosphorus availability in this soil.

THE EFFECTS OF DIFFERENT RATES, TIMES, AND METHODS OF APPLICATION OF VARIOUS FERTILIZER COMBINATIONS ON THE YIELD AND QUALITY OF HARD RED WINTER WHEAT, 1949-50.

By B. C. Williams and F. W. Smith. Soil Sci. Soc. Amer. Proc. 18: 56-60. 1954.

A study was made to determine the effect of nitrogen fertilizer, alone and in combination with phosphate and potash fertilizers, on the yield and quality of wheat; to determine the effect of nitrogen carrier on wheat yield and quality; and to determine the effect of time and method of application of nitrogen fertilizer on yield and quality of wheat. Yields of wheat were increased at all locations by the use of nitrogen fertilizers. Increasing the rate of nitrogen applied gave varied but similar results. Increases in yields were noted for using phosphatic fertilizer in the treatment while the use of potash fertilizer had no effect, beneficial or detrimental, on yields of wheat. The later applications of nitrogen fertilizer gave more increase in yield of wheat than did nitrogen fertilizer broadcast before seeding. Only at Manhattan was NH_4NO_3 significantly superior to $CaCN_2$ in increasing the yields of wheat. At other locations, no differences in effect of type of carrier of nitrogen on yields of wheat were observed.

THE RELATIONSHIP BETWEEN POPULATIONS OF ALFALFA INSECTS AND SOIL TREATMENTS WITH BORON

By J. T. Medler and A. R. Albert. Jour. Econ. Ent. 46: 793-797. 1953.

This study was to determine if soil applications of boron might affect insect population on the alfalfa plants treated. The studies on sandy soils in Wisconsin during

this investigation clearly showed alfalfa treated with borate and insecticide made better growth, was much greener, blossomed more freely, and produced more seed than untreated alfalfa. The beneficial effect of boron was associated with soil moisture, being more pronounced under drought conditions. Control of injurious insects for alfalfa seed production was of little value where boron deficiency was uncorrected. Adequate boron and correct use of insecticide were essential for alfalfa seed production on the sandy and sandy loam soils of Wisconsin.

HARVEST PRACTICES ON THE PERFORMANCE OF ALFALFA

By H. O. Graumann, J. E. Webster, C. L. Canode, and H. F. Murphy. Okla. Agr. Expt. Sta. Bul. B-433. 1954.

When grown for hay only and harvested uniformly at various stages of development, annual forage production was increased as maturity advanced to the full-bloom stage. Relative yields of moisture-free hay from two 1-year tests cut regularly at the bud, one-tenth bloom, or full-bloom stages averaged 100, 116, and 123 percent, respectively. While prebud to bud-stage harvesting produced hay higher in ash and protein than later maturity harvests, the annual yield of feed constituents per acre was usually lower because of lower hay yields.

CRUDE PROTEIN OF CORN GRAIN AND STOVER AS INFLUENCED BY DIFFERENT HYBRIDS, PLANT POPULATIONS, AND NITROGEN LEVELS

By M. S. Zuber, G. E. Smith, and C. W. Gehrke. Agron. Jour. 46: 257-261. 1954.

The crude protein content of corn grown was significantly altered by applications of nitrogen. The hybrid, Mo 804, had a higher crude protein content than did US 13 or Dixie 17. Increasing the plant population caused a slight decrease in crude protein content. Application of 50 pounds of nitrogen gave a significantly lower protein content in the grain than where no nitrogen was applied. The percentage crude protein in stover was increased as additional nitrogen was applied. These results indicate that crop yields alone are an insufficient measure of the effects of nitrogen fertilization.

THE INFLUENCE OF VARIETY AND PREDISPOSING FACTORS ON THE OCCURRENCE OF YELLOW BERRY (STARCHINESS) IN WHEAT

By B. J. Sallans and P. M. Simmonds. Canad. Jour. Agr. Sci. 34: 393-405. 1954.

Greenhouse experiments have shown that yellow berry or piebald in wheat was increased by the addition of monobasic potassium phosphate to the soil. On the other hand, the addition of sodium nitrate reduced the incidence of yellow berry thus lending support to the findings of other authors that a shortage of nitrates in the soil may be the main cause of the condition. Plants which were inoculated with Pythium arrhenomanes Drechs. had much lower percentages of yellow berry than uninoculated plants. Lowering the moisture level of the soil also reduced the incidence of yellow berry.

Evidence is presented to show that factors which increase yields of grain tend to increase the percentages of yellow berry by increasing carbohydrates in relation to proteins. The exception to this general rule is the increase in yield resulting from nitrogen-containing fertilizer which is accompanied by reduced percentages of yellow berry. Greenhouse methods to test the inherent tendency of wheat varieties to yellow berry indicate that Garnet and Regent are not readily affected; Red Bobs, Marquis, and Mindum become affected quite readily under favourable conditions and Thatcher is intermediate in reaction.

RELATIVE EFFICIENCY OF LATTICE AND RANDOMIZED BLOCK DESIGNS FOR FORAGE CROP TRIALS.

By C. P. Wilsie. Agron. Jour. 46: 355-357. 1954.

Analyses of 28 lattice-design experiments with forage crops indicated average gains in efficiency of 64 percent for alfalfa, 39 percent for red clover, and 45 percent for brome grass as compared with randomized block analyses. An average gain in efficiency of 52 percent for all years and species suggests that 4 replicates in a lattice design would give approximately the same precision as 6 replicates in randomized blocks. This indicates a decided saving in land and labor when lattice designs are used.

In general, the data indicated no definite relation between the number of strains tested and the relative efficiency of the lattice under the conditions of these experiments.

COMBINE HARVESTING OF SMALL-SEEDED LEGUMES

By P. R. Bunnelle, L. G. Jones, and J. R. Gass. Agr. Engin. 35: 554-558. 1954.

Successful harvesting of small-seeded legumes depends as much on the cultural practices used to produce the seed crop as on the operation of the harvester. Combines, when properly adjusted, are capable of doing a good job of harvesting these crops, although most machines require some modification for the best performance.

At normal load rates, the factors affecting combine performance in small-seed legume harvesting are: Cylinder speed causes seed damage, loss of unthreshed seed, loss of free seed over the straw walkers, and recovery of free seed by the cleaning shoe.

HARVESTING SMALL GRASS AND LEGUME SEED

By J. K. Park. Agr. Engin. 35: 562-564. 1954.

Studies in South Carolina show that weather and cutterbar shattering cause the greatest losses in harvesting fescue and lespedeza seeds. However, in crimson clover threshing loss is the major problem, and angle-bar cylinders have been preferable to other types in harvesting this crop. Direct combining appears generally to be the best method of harvesting these crops. Chemical defoliation may be profitable in some cases but further tests are necessary to determine its value.

Cylinder speed and clearance and ground speed are very important in harvesting crimson clover. Under the humid conditions usually present, cylinder speed should be as high as possible and clearance as small as possible without causing excessive damage of seed. Ground speed should be as low as practicable.

EFFECT OF NITROGEN FERTILIZATION ON YIELD, CULM NUMBER AND PROTEIN CONTENT OF CERTAIN SPRING WHEAT VARIETIES

By F. H. McNeal and D. J. Davis. Agron. Jour. 46: 375-378. 1954.

Nine varieties of spring wheat were grown under irrigation in 1952 in a split-plot experiment with three levels of nitrogen fertilizer. Heading date was hastened by 1 to 4 days in the plots receiving nitrogen applications. Test weight was not affected by nitrogen fertilization. The variety X-fertilizer interaction for yield and culms was not significant.

THE RELATION OF AMMONIUM AND SULPHATE IONS TO MAGNESIUM DEFICIENCY IN TOBACCO

By E. T. McEvoy. Canad. Jour. Agr. Sci. 34: 281-298. 1954.

An experiment was conducted with flue-cured tobacco in sand culture under conditions of controlled nutrient supply to study the relation of ammonium and sulphate ions in the nutrient medium to magnesium deficiency in tobacco. A series of 9 nutrient solutions was used, comprising 3 concentrations of ammonium nitrogen in factorial combination with 3 concentrations of sulphate sulphur. The total concentration of nitrogen was held at a constant level in all treatments by the necessary addition of nitrate.

The yield decreased with increased ammonium supply. Neither sulphate nor the interactions between sulphate and ammonium had a significant effect on yield. Plants which received high ammonium supply combined with either intermediate or high sulphate supply manifested chlorosis characteristics of magnesium deficiency. The content of magnesium in the leaves was depressed by each of NH_4^+ and $\text{SO}_4^{=}$ supply independently but to a greater degree by the former and reached the lowest level at high NH_4^+ and high $\text{SO}_4^{=}$ supply combined.

ESTABLISHMENT OF LEGUMES AS INFLUENCED BY THE RATE OF SOWING THE OAT COMPANION CROP

By D. Smith, H. J. Lowe, A. M. Strommen, and G. N. Brooks. Agron. Jour. 46: 449-451. 1954.

The influence of four varieties of spring oats sown at different rates and used as a companion crop for the establishment of stands of alfalfa and red clover was studied from 1947 to 1950 at four stations in Wisconsin.

Weeds were prominent in the thinly sown oats on the heavy soils, and on these soils the stands of legumes were not greatly reduced as the oat-sowing rate was increased. Differences in the effects of the rates of sowing the oats on the legume stands were leveled out in part by favorable spring moisture conditions and by the higher weed populations which occurred in the oats sown at lighter rates. The weeds tended to equalize the total amount of growth on the plots.

Competition for moisture appeared to be the major factor in influencing the establishment of the legumes on the sandy soils where in general poor stands of legumes occurred under the heavy rates of sowing the oats. The oat varieties, Clinton, Bonda, Vicland, Forvic, with the experimental design used, showed no significant differences on the establishment of the legume stands.

Pasture and range

A COMPARISON OF SURFACE SOIL PROPERTIES UNDER MESQUITE AND PERENNIAL GRASS

By H. A. Paulsen, Jr. Ecology 34: 727-732. 1953.

Samples from the surface inch of soil from native black grama-Rothrock grama grassland areas and interspersed areas recently invaded by mesquite were analyzed for physical and chemical properties. The samples were obtained from the foothill vegetation type on the Santa Rita Experimental Range in southeastern Arizona. The soil of the sampling area is typed as a Tumacacori coarse sandy loam.

The laboratory analyses indicate the soil under the mesquite cover to be deteriorated in both chemical and physical properties. The latter is believed of greater

importance since the indicated reduction in the nutrient capital is not believed to have reached the minimal requirements of the grasses.

BURNING AND GRAZING IN COASTAL PLAIN FORESTS

By L. K. Halls, B. L. Southwell, and F. E. Knox. Ga. Agr. Expt. Sta. Bul. 51. 1952.

Experiments were conducted at Alapaha, Ga., from 1942 to 1949 to study the effects of several frequencies of burning on vegetation and animal performance in the longleaf-slash pine forests of southeastern United States. The experimental area, located in the lower Coastal Plain or "Flatwoods," was divided into eight 50-acre ranges. Treatments, replicated twice, were: annual burning, burning one-half of the range each year, burning one-third each year, and complete protection from fire. Each range was annually grazed by six steers or heifers. Within each range were located a series of permanent plots, grazed and ungrazed, from which data were taken periodically to study the effects of fire and grazing on herbaceous vegetation, shrubs, and trees.

Burning appears essential for maximum cattle production, but if employed frequently, will impair slash-pine reproduction. However, proper use and timing of prescribed fire is the key to a successful combination of cattle and timber raising. This study indicates that with protection from fire, satisfactory slash-pine reproduction will come in. During this period, grazing may be desirable to reduce fuel accumulation. After the trees are 10-15 feet tall, they can survive periodic prescribed burns, and an owner increases his beef returns while the forest is maturing.

FERTILIZATION OF SOME RANGE SOILS IN THE ROCKY MOUNTAINS

By J. L. Retzer. Jour. Range Mgt. 7: 69-73. 1954.

Under conditions of this study, no important increases in native herbage were obtained by topdressing with 14 fertilizers and minor elements on 7 range soils tested in the Rocky Mountains. Nitrogen fertilization produced increased herbage on soils from granitic materials for 1 to 2 years following application. Applications of N

resulted in no response on soils from basalt and andesite. Responses to additions of K were not conclusive but were strong enough to suggest that the soils from granitic materials are deficient in K. The response of P fertilizers was indefinite on soils from granite. There was no growth response to additions of minor elements on any soil.

GRAZING CRESTED WHEATGRASS BY SHEEP

By A. T. Bleak and A. P. Plummer. Jour. Range Mgt. 7: 63-68. 1954.

A grazing study with sheep was conducted on six 1-1 2-acre dryland pastures in typical spring-fall range in Utah with crested wheatgrass as the dominant species. Beardless bluebunch wheatgrass and bulbous bluegrass occurred as secondary components. Three intensities of use were applied (light, moderate, and heavy) with grazing starting when crested wheatgrass was 2 to 3 inches high (early) and 4 to 5 inches high (deferred). After 7 years of grazing, injurious effects are obvious where crested wheatgrass has been heavily utilized (88 percent use). Under heavy grazing, production has decreased, most grass clumps have died in the middle, plants are small, and there is a marked growth of Russian thistle generally over the pastures. Although production has declined with aging of the seedbed stands, crested wheatgrass appears to have maintained equally good production under light (59 percent) and moderate (71 percent) use during the 7 years.

Because of the low preference of sheep for beardless bluebunch wheatgrass under light and moderate grazing as compared with crested wheatgrass, its use in mixtures with crested wheatgrass is not recommended.

FORAGE UTILIZATION BY CATTLE ON NORTHERN GREAT PLAINS RANGES

By C. E. Holscher and E. J. Woolfolk. U. S. Dept. Agr. Cir. 918. 1953.

To develop standards of forage utilization, a study was conducted on experimental pastures at the U. S. Range Livestock Experiment Station near Miles City, Mont., from 1939 through 1945. Two sets of 6-range pastures, 1 for summer grazing and 1 for winter grazing were used. Of these, 4 were lightly stocked, 4 moder-

ately, and 4 heavily. Each set had a central well, from which the wedge-shaped pastures radiated. Utilization of important forage species was observed at regular intervals along lines run across these pastures at different distances from the watering tanks. Observations over the 7-year period revealed considerable variation in utilization of the important forage species from year to year, between vegetation subtypes, between rates of stocking, and at different distances from stock water on both summer and winter range.

Greatest differences in utilization were found on winter range in blue grama and threadleaf sedge, each being grazed more than three times as heavily in 1 year as in another. Utilization of bluestem wheatgrass ranged from 18-53 percent on winter range but was less variable on summer range.

Bottom subtypes were more heavily grazed by cattle than either the upland or the hills. On summer range, the upland subtype was most lightly grazed, but on winter range there was little difference between the upland and the hills. Bluestem wheatgrass, the most abundant species in all three subtypes had 78 percent of the plants grazed on the bottom subtype as compared to 47 percent on the upland and 57 percent on the hills.

Rates of stocking were clearly reflected by differences in utilization of the major species. On heavily stocked summer range these species were utilized 45 to 60 percent more than on moderately stocked range, while on lightly stocked range they were utilized 15 to 25 percent less than under moderate stocking.

ECOLOGICAL EFFECTS OF PLANNED BURNING OF SAGEBRUSH-GRASS RANGE ON THE UPPER SNAKE RIVER PLAINS

By J. P. Blaisdell. U. S. Dept. Agr. Tech. Bul. 1075. 1953.

Dense stands of big sagebrush cause a serious grazing-management problem on extensive areas of western range. Fire has been widely used in sagebrush eradication, but unrestricted burning followed by overgrazing has often resulted in serious range depletion. Several studies have indicated that planned burning can be a valuable tool in improvement of sagebrush-grass ranges. This bulletin describes changes in vegetation and soil on two planned burns on the upper Snake River Plains over 12- and 15-year periods.

All grasses were injured by burning, but thickspike wheatgrass, plains reedgrass, and bluebunch wheatgrass recovered rapidly and made substantial increases within 3 years as compared to the same species on unburned control areas. Other grasses were slower to recover, but by 1948 nearly all were producing as much or more herbage on burned areas than on the unburned. Some of the finer bunchgrasses were apparently damaged, especially by heavy burns. Although burning caused increased yields of several grasses, only thickspike wheatgrass and plains reedgrass on the Clark County burn increased enough to be of practical importance as late as 1948. As with grasses, forbs were injured slightly by burning, but most of the rhizomatous species recovered rapidly and within 3 years were producing more herbage on burned than on unburned range. Yield of suffrutescent species was greatly reduced initially, but none of the perennial forbs were permanently damaged, and many apparently benefited from reduced competition as shown by significantly higher "all forbs" herbage production.

INCREASING FORAGE YIELDS AND SHEEP PRODUCTION ON INTERMOUNTAIN WINTER RANGES

By S. S. Hutchings and G. Stewart. U. S. Dept. Agr. Cir. 925. 1953.

From the findings at the experimental range, condition of winter range areas has been grouped into four broad classes which can be identified by relatively few indicators. These classes are: good, fair, poor, and very poor. Knowledge of the extent of these condition classes on a range is essential to the application of proper utilization standards and stocking rates.

Records obtained at the experimental range indicate that approximately the following proportion of the herbage of major forage species can be eaten during the winter period without impairing their continued productivity: For Indian ricegrass 75 percent, black sagebrush 60 percent, winterfat 55 percent, and galleta about 45 percent.

To provide for reasonable stability in winter grazing and to assure an adequate forage supply in most years, a basic stocking rate that will use 75 percent of average forage production is recommended. Grazing capacities of range subtypes in fair to good condition are 1-1/2 to 2-1/2 times greater

than those in poor condition. On ranges in fair to good condition 1 to 3.5 acres are required per sheep per month whereas on those in poor condition 2.3 to 5.7 acres are required.

Studies at the Desert Experimental Range indicate that certain management practices are of benefit to both ranges and sheep. These include subdivision of large grazing allotments so that grazing use may be rotated from year to year, use of open herding and one-night bedgrounds, leaving the range early to avoid grazing during the late winter period when many of the major forage plants begin to grow, and providing water for sheep each day.

THE COMPOSITION AND NUTRITIVE VALUE OF HAY GROWN IN THE EAST OF SCOTLAND AND THE INFLUENCE OF LATE APPLICATION OF NITROGENOUS FERTILIZERS

By F. E. Moon. Jour. Agr. Sci. 44: 140-151. 1954.

Examination of the composition of hay grown in the east of Scotland during the 4-year period 1948-51 confirmed earlier work indicating the low protein content of this material. In addition, the digestibility of the protein was found to be low; particularly for seeds-hays, most of which contained insufficient digestible protein to balance the starch equivalent in meeting the maintenance requirements of cattle.

In nutritive value the seeds-hays were markedly inferior to samples of England and Wales examined by other workers, but very similar to mature ryegrass hay grown in northern Ireland.

Applications of sodium nitrate or calcium nitrate about 10 to 20 days before mowing produced variable responses in the unusually dry season of 1949, but in other years significant increases in protein content were almost invariably obtained.

MEETING DROUGHT ON SOUTHERN ARIZONA RANGELANDS

By H. G. Reynolds. Jour. Range Mgt. 7: 33-40. 1954.

Drought is a recurring problem in desert-grassland ranges. It always lowers forage production, and sometimes necessitates livestock reduction to prevent overutilization of the forage resources. This analysis defines drought, relates it to

livestock reductions, and describes some practices which can be used to reduce the disastrous effects of drought. Data extend over 30 years of record for a foothill pasture on the Santa Rita Experimental Range--an area representative of desert grasslands of southern Arizona.

Drought is defined as below average rainfall. Drought or summated departures of successive years of below-average summer rainfall are closely related to forage losses. Drought severity is designated as slight, moderate, and severe, depending upon forage scarcity. The last two require livestock reductions to prevent overutilization of the forage crop whereas slight droughts can be avoided by conservative stocking.

Livestock reductions to provide adequate forage result in maintenance of calf weights even during a severe drought. Slight reductions in calf crops during drought are presumed to be caused by nutritive deficiencies of the forage.

Proper utilization is the key to maintenance of desert grasslands and should average 35 to 55 percent of the annual herbage produced by perennial grasses. As an average estimate for desert-grassland ranges, stocking should be 40 percent below the longtime average about 35 percent of the time when droughts reach moderate and severe intensity.

MODERN METHODS OF GETTING UNIFORM USE OF RANGES

By R. E. Williams. Jour. Range Mgt. 7: 77-81. 1954.

Uniform and proper use allows maximum sustained harvest of forage by livestock. Many practices being used by ranchers to get uniform use of ranges are not new, but have been adapted to modern ranching operations. Stock-water facilities, including temporary types, fencing, and herding, are the most widely used practices which contribute to uniform range use. Salt, salt-meal mixtures, and supplemental feeds placed away from water provide flexibility because they can be moved as grazing conditions change. Increasing accessibility of ranges relieves use of overgrazed areas and makes additional forage available to livestock. The size of grazing unit, the number of range sites, the range-condition pattern, and the habits of range livestock are the points a range man must study to determine what practices will help him achieve uniform use on any range.

A METHOD FOR RATING THE SUCCESS OF RANGE SEEDING

By D. H. Hyder and F. A. Sneva. Jour. Range Mgt. 7: 89-90. 1954.

A method for determining the success attained on seeded rangeland is described, and it is fast and easy to use. A welded steel-rod frame 2 x 2 feet square, subdivided into four units 1 x 1 foot square, is used to determine the presence or absence of the seeded species in a sample consisting of 100 one-square-foot observation units (25 randomly distributed frames). A unit is considered stocked if any portion of the basal area of the seeded species falls inside the one-square-foot frame. Observations are most easily made when the herbage does not obscure the basal portions of the plants.

The number of units stocked in 100 observations is accumulated on a tally register and recorded in percent as an expression of seeding success. The following success-rating scale appears to be suitable for areas receiving 10-12 inches average annual precipitation.

<u>Success rating</u>	<u>Percentage stocked</u>
Excellent	50% or more
Good	40 to 50%
Fair	25 to 40%
Poor	10 to 25%
Failure	9% or less

CONTOUR FURROWS ON PASTURE AND RANGE LAND

By C. D. Brehm and H. E. Holmsten. Jour. Soil and Water Conserv. 9: 111-114. 1945.

On range and pasture land with runoff, contour furrows may significantly reduce runoff, erosion, and fertility losses. Moreover, they may increase soil moisture, forage yields and plant residues, spread water effectively, and provide some low cost water storage.

RESEEDING DESERT GRASSLAND RANGES IN SOUTHERN ARIZONA

By D. Anderson, L. P. Hamilton, H. G. Reynolds, and R. R. Humphrey. Ariz. Agr. Expt. Sta. Bul. 249. 1953.

Reseeding sites should be selected with care. Rather level land with deep, fertile,

medium-textured soils responds most readily to reseeding. No reseeding is recommended where average annual rainfall is less than 11 inches. Ranges that are to be reseeded should not support more than scattered stands of mesquite, burroweed, cactus, annual weeds, or other competitive species. If these are abundant, they should be controlled prior to seeding operations. Reseeded areas should be readily subject to managed grazing and should fit in well with the overall ranch-management plan.

The best sites for reseeding are those with productive, medium-textured soils, above 4,000 feet in elevation, and that receive 14 inches or more annual rainfall. On these sites, Lehmann and Boer lovegrass are the best species to use. Lehmann is the easier to establish, but Boer is more palatable and longer lived. Cotton top, black grama, and blue grama can also be used but are more difficult to establish. Weeping lovegrass and sideoats grama are suitable for the more moist sites. Wilman lovegrass can be used where temperatures do not fall below 10°F. On upland areas receiving less than 14 inches of rainfall Lehmann lovegrass is the only species that can be generally recommended. Boer lovegrass can be used on the more moist sites in this zone if good seedbeds have been prepared. Wilman lovegrass can be used in warm localities. On swale or bottomland sites that receive runoff from adjacent ranges, Boer and Lehmann lovegrass, Johnsongrass and blue panicum in particular are recommended. Reseeding success is much more certain if good seedbed has been prepared. Pitting to conserve moisture, followed by culti-packer-seeding, has been a consistently successful method.

EFFECT OF GRAZING INTENSITY UPON VEGETATION AND CATTLE GAINS ON PONDEROSA PINE-BUNCHGRASS RANGES OF THE FRONT RANGE OF COLORADO

By. W. M. Johnson. U. S. Dept. Agr. Cir. 929. 1953.

Grasses and sedges produced 94 percent of the total palatable herbage. Mountain muhly and Arizona fescue were the most abundant forage species. The use of an individual species was generally proportional to the intensity of grazing on the area on which it occurred. An exception was Kentucky bluegrass, which was grazed very closely wherever it grew. Blue grama

was not used in important amounts under light and moderate grazing and was grazed only lightly under heavy grazing. Arizona fescue, little bluestem, Kentucky bluegrass, danthonia, and sedges were grazed most readily in the early summer. Mountain muhly was the most abundant forage in late summer.

Heavy grazing resulted in lowered production of grass and sedge herbage. Under moderate and light grazing herbage production was in general maintained throughout the study. The vigor of mountain muhly and Arizona fescue was best under light grazing, nearly as good under moderate grazing, but was reduced where grazing was heavy. In contrast, blue grama was the most productive on the heavily grazed range and least productive under light grazing.

Cattle weight gains were associated with grazing intensity. Average gains from 1942-47, for the 5-month grazing season, were 181 pounds per head in the heavily grazed pastures, 222 pounds in those moderately grazed, and 236 pounds in those lightly grazed. On a per-acre basis weight for the grazing season averaged 14.8 from heavy grazing, 16.0 from moderate, and 8.5 from light.

RESEEDING SOUTHWESTERN RANGE LANDS WITH CRESTED WHEATGRASS

By H. G. Reynolds and H. W. Springfield. U. S. Dept. Agr. Farmers' Bul. 2056. 1953.

Crested wheatgrass forage production may be maintained and the best individual animal-weight gains may be obtained on Arizona and New Mexico reseeded ranges when the amount of herbage eaten averages about 45 percent by weight and does not exceed 55 percent in any year.

Range plantings of crested wheatgrass can sometimes be harvested profitably for seed. In northern New Mexico operators have harvested more than 350 pounds of seed per acre on range plantings 2 years' old. However, 100 pounds of seed per acre is generally considered a satisfactory yield from dryland plantings. On favorable ground, ordinary grain combines, if properly adjusted, can be used to harvest crested wheatgrass seed.

Other benefits, besides the production of more forage, may be obtained by restoring deteriorated rangelands with crested wheatgrass. On many deteriorated sites, replacement of a scant annual grass

and weed cover with perennial grass reduces soil erosion and increases the absorption of rainfall and snowmelt by the soil. Moreover, a good stand of the perennial crested wheatgrass is more effective than the shrubs it replaces in making it easy for water to enter the soil, and in reducing surface runoff and erosion.

SUDAN FOR GRAZING AND HAY

By E. C. Holt and F. L. Vavra. *Tex. Agr. Expt. Sta. Prog. Rpt.* 1657. 1954.

Results of the seeding studies suggest that broadcast and drill plantings are satisfactory for hay production. For grazing throughout the growing season, row seedings are the most dependable. Moisture conditions will influence these conclusions.

Sudan planted in 10-inch rows in 1952 in an irrigation test at the Brazos River Valley Laboratory produced slightly more forage per acre than the irrigated Sudan variety test planted in 40-inch rows. Available moisture and fertility will also influence optimum seeding rates but the results from these tests indicate that 7 to 10 pounds of seed in 40-inch rows and 20 pounds in drill and broadcast rows will give satisfactory results. Heavier seeding rates did not depress yields; they might be beneficial under better fertility and moisture conditions. The use of cowpeas with Sudan does not improve yield or quality to any great extent.

ROOT PENETRATION, DISTRIBUTION AND ACTIVITY IN SOUTHERN GRASSES MEASURED BY YIELDS, DROUGHT SYMPTOMS AND P^{32} UPTAKE

By G. W. Burton, E. H. DeVane, and R. L. Carter. *Agron. Jour.* 46: 229-233. 1954.

Penetration, yield, and activity of roots of several Southern grasses grown on a deep sand were studied at Tifton, Ga., beginning in 1951. Heavy fertilization increased the rate of root penetration in 1951, but had no effect in 1952.

Plugs of year-old sod of eight grasses were planted in quadruplicate on March 21, 1952, over P^{32} which had been placed at depths of 2, 4, 6, and 8 feet. Three months later, roots had reached the following depths as indicated by P^{32} activity of the aboveground parts: Coastal Bermuda--8 feet; Pangola--6 feet; Common Bahia,

Pensacola Bahia, tall fescue and carpet grass--2 feet.

APPLICATION OF RANGE ECOLOGY IN THE DETERMINATION OF RANGE CONDITION TREND

By K. W. Parker. *Jour. Range Mgt.* 7: 14-23. 1954.

The use of knowledge of plant ecology in answering range problems began well over a half century ago and has been consistently drawn upon throughout the intervening years. Ecologic knowledge has been especially helpful in placing range-condition classification on a sound natural basis. Range-condition classes are a practical means of recognizing the major successional stages of broad-plant communities as influenced by grazing use. Likewise, ecologic knowledge has been useful to the range manager in the estimation of trend and in the determination of satisfactory management practices.

The most reliable criteria for developing standards for classifying condition of vegetation are: (1) density index of plant or forage cover; (2) composition of vegetation as to species, grouped in accordance with their reaction to grazing use; and (3) vigor of the desirable forage species. Soil condition factors most important and suitable for measurement or estimation are: (1) amount of litter coverage; (2) current erosion; and (3) stability as indicated by amount of living and dead cover.

STIMULATION OF NATIVE ANNUAL CLOVERS THROUGH APPLICATION OF SULFUR ON CALIFORNIA FOOTHILL RANGE

By J. R. Bentley and L. R. Green. *Jour. Range Mgt.* 7: 25-29. 1954.

The use of commercial fertilizers to improve California foothill ranges has been studied on plots at the San Joaquin Experimental Range since 1914. Stimulation of native clovers through application of sulfur-bearing fertilizers has proved to be a positive method of improving the annual-plant forage on the soils of granitic origin.

The response to sulfur fertilization was delayed for one season if the weather was unfavorable for legume growth during the year of application. Stimulation of legumes, particularly native annual clovers, was the first marked response to fertilizers con-

taining sulfur. Increased production of both grasses and clovers occurred during the year after heavy legume growth, and there was a holdover response in these plants during the third year. Improvement in both quality and quantity of forage as a result of increasing legume production has been very striking.

THE ESTABLISHMENT OF DALLISGRASS

By E. C. Holt and H. C. Hutson. Tex. Agr. Expt. Sta. Prog. Rpt. 1662. 1954.

Results of the 1951 and 1952 fall plantings at College Station indicate good stands of Dallis grass may be obtained from late fall and winter planting, provided good quality seed are used. Such plantings should be late enough to insure no germination until early spring. Since Dallis seedlings sometimes emerge during warm periods in the winter and are subject to being killed by frost, later winter and early spring plantings are most dependable. Seed quality is one of the most important factors in the establishment of Dallis grass. Seed which have been stored through the summer with uncontrolled temperatures should have a new germination test before planting. Seeding rates should be adjusted on the basis of seed quality. If weed invasion is serious, seeding in late winter or early spring into oats, Berseem clover, or Crimson clover mulch will give best results. If weed invasion is not serious, late winter or early spring seeding of Dallis grass on a clean seedbed will give best results.

If a companion crop is used, row spacings of 14 to 20 inches will give Dallis a better opportunity to become established. The companion crop should be used in the spring by grazing or mowing to prevent excessive growth and competition with Dallis. Where seed hay is available, it is one of the best methods of establishing Dallis.

UTILIZATION OF FRINGED SAGEWORT ON A WINTER SHEEP RANGE

By E. F. Spang. Jour. Range Mgt. 7: 73-74. 1954.

The use of fringed sagewort by sheep on winter range was determined by weight-sampling before and after grazing. The average use on the range studied was 60 percent.

COMMON USE OF SUMMER RANGE BY SHEEP AND CATTLE

By C. W. Cook. Jour. Range Mgt. 7: 10-13. 1954.

Common use of summer range in the intermountain area results in more uniform use than is obtained by single use provided the combined numbers of each kind of animal are commensurate with forage production. A summer range area grazed by sheep and a comparable range grazed by cattle were studied to compare the foraging habits of the two kinds of livestock and to evaluate the desirabilities of common use compared with single use.

Cattle ate considerable quantities of the grasses, moderate amounts of the forbs, and only limited quantities of the brouse, whereas sheep ate sparingly of the grasses and consumed large quantities of the forbs and brouse.

Assuming that present stocking capacity was correct and that the heaviest use on any particular species by either kind of animal was obtained under common use, the area would furnish 652 animal units of grazing when stocked with the proper proportions of sheep and cattle. However, if the entire area were grazed by cattle alone it would furnish grazing for 560 animal units and when grazed only by sheep, it would furnish 306 animal units. Thus the area would furnish more grazing from common use than from single use and was judged 1.83 times more suitable for cattle than for sheep.

Calculated grazing capacities under various combinations of sheep and cattle showed that conversion ratios for replacing one kind of animal with another are not constant until after the point of most effective use is reached when changing from one kind of animal to another.

FORAGE CROPS EVALUATION AND MANAGEMENT STUDIES, PROGRESS REPORT, 1953.

By W. W. Huffine, J. Q. Lynd, and W. C. Elder. Okla. Agr. Expt. Sta. Mimeo. Cir. M-261. 1954.

This circular is divided into three parts. Each part deals with a specific phase of the pasture problem.

Part I reports results of pasture-adaptation tests. Forage yields and protein

content are presented for a number of plants grown on the Perkins Farm near Stillwater for the years 1952 and 1953. Both yields and protein content varied widely with different grasses and legumes.

The yield of sweetclover hay averaged about 1-1/4 tons per acre. It had a protein content of about 32 percent. The yield of alfalfa hay was about twice that of sweetclover, but the protein content was only about 17.5 percent. The hay yield of some of the strains of birdsfoot trefoil was about equal to that of alfalfa but the protein content was only about 12.5 percent. Both hay yields and protein content of the strains of fescue and sideoats grama tested were lower than that for birdsfoot trefoil.

Part II is a report of studies conducted at the Southeast Pasture Fertility Experiment Station at Colgate for 1945 to 1954. Part III is a progress report of pasture studies, 1953.

PROGRESS REPORT OF GRAZING EXPERIMENTS: 1945-1953, SOUTHEAST OKLAHOMA PASTURE FERTILITY RESEARCH STATIONS, COLGATE, OKLA.

By J. Q. Lynd, W. C. Elder, and R. Totusek. Okla. Agr. Expt. Sta. Cir. M-263. 1954. [Mimeo.]

Pastures of common bermudagrass with legumes were established on four land types receiving various soil treatments. The annual production of beef per acre over 8 years on an upland prairie soil was 66 pounds for unfertilized, 93 pounds for limed, and 126 pounds on limed and low rates of 0-20-0 fertilizer. A claypan prairie soil receiving lime and a low rate of 0-20-0 produced 122 pounds of beef per acre. Limed alluvial bottomland soil produced 159 pounds and a similar soil receiving low rates of lime and 0-20-0 per acre produced 219 pounds.

GRAZING AND FEEDING TRIALS, BLACKLAND EXPERIMENT STATION, 1952-53.

By J. H. Jones, R. C. Henderson, and R. M. Smith. Tex. Agr. Expt. Sta. Prog. Rpt. 1693. Cattle Ser. 115. 1954.

More salable market weight was realized by using steers than by using heifers. The amount of gain and its value were roughly proportional to the amount of grain or other concentrates used.

Corn was more economical and a more profitable grain for fattening, at the prices charged than sorghum grain or barley.

FEEDING GUAR BEANS TO STEER CALVES ON GRASS

By E. H. McIlvain. U. S. Dept. Agr., Agr. Res. Serv. and Okla. Agr. Expt. Sta. Prog. Rpt. [Mimeo 1954.]

Guar beans are an acceptable protein supplement for wintering steer calves on grass. A daily ration of 3.5 pounds of rolled guar beans per weaner steer produced slightly greater gains per head and more "bloom" than a standard daily steer ration of 2 pounds of 41-percent cottonseed pellets. This preliminary information was obtained during the 158-day winter grazing period, November 13, 1953, to April 20, 1954, at the U. S. Southern Great Plains Field Station, Woodward, Okla. Results given are the first data from a planned 3-year study. Although definite conclusions and recommendations cannot yet be made, results are encouraging that guar beans can be used satisfactorily as a protein supplement for beef cattle.

PERENNIAL WARM SEASON GRASS TEST, LOWER RIO GRANDE VALLEY OF TEXAS

By J. H. Barton. Texas Agr. Expt. Sta. Prog. Rpt. 1698. 1954.

Any of the five grasses--Rhodes grass, buffel grass, Coastal Bermuda, Angleton, and Birdwood grass--can be incorporated into a pasture plan for the Lower Rio Grande Valley. Because of its susceptibility to Rhodes grass scale, Rhodes grass works into a very good rotation with alfalfa, on a 2-year basis.

Coastal Bermuda and buffel are recommended as base grasses on loamy to sandy soils. Birdwood can be used on sandy soils as a base grass provided it is supported by a well-rounded forage program. Angleton is recommended as a base grass on heavy clays.

VALUE OF PASTURE FOR DAIRYING IN EAST TEXAS

By S. E. Carpenter, P. R. Johnson, and R. E. Leighton. Tex. Agr. Expt. Sta. Prog. Rpt. 1703. 1954.

Pasture A produced 15 percent more milk than pasture B during the 3 years.

The value of the 15-percent milk increase was \$530. The feed cost of producing milk in pasture A was 32 cents less per hundred pounds than in pasture B. This was a gain of \$192 for the 3 years. When the \$192 is added to the \$530 we have a return of \$722 for the \$322 spent on pasture A. On a per-year basis this is a return of \$40 for each \$18 spent.

A farmer starting a dairy in east Texas would need only 60 acres of pasture for 30 cows if he would handle it as pasture A. While if he handles it as pasture B he would need 150 acres to pasture 30 cows. Additional acreage would be required for hay and silage crops.

BETTER QUALITY MOUNTAIN MEADOW HAY THROUGH EARLY HARVESTING AND FERTILIZATION

By D. E. Miller and M. Amemiya. Colo. Agr. Expt. Sta. Tech. Bul. 54. 1954.

An experiment was conducted on a mountain hay meadow near Gunnison, Colo., to determine the effects of maturity stage at harvest time and fertilization with commercial fertilizers on the growth of the forage plants at high altitudes.

The data indicate the yield of forage continues to increase throughout the growing season as the plants mature. Regardless of whether the first harvest was early or late in the season, if the regrowths were included in the total yields of hay, there were no significant differences in the total dry hay produced. The forage produced tended to become lower in the percentages of crude protein and total phosphorus as it became more mature.

The data indicate the plants continue to increase in production of crude protein and phosphorus until near the end of the growing season. The greatest total production of protein and phosphorus, including both the regrowth and initial harvest, was obtained when the initial harvest was taken near the end of June.

CHEMICAL COMPOSITION OF SOME FORAGE GRASSES: I. CHANGES WITH PLANT MATURITY

By T. C. Phillips, J. T. Sullivan, M. E. Loughlin, and V. G. Sprague. Agron. Jour. 46: 361-369. 1954.

Eight grasses common to the Northeastern States were grown in small plots

and subjected to chemical analysis for the major organic and carbohydrate constituents. Data are reported on the composition during the spring months when the grasses are approaching maturity and when they are commonly cut for silage or hay.

Grasses, during the progress of maturation, underwent continuous decrease in protein, acid-soluble ash, and ether extract, and a continuous increase in lignin.

Highly significant positive correlations were found among lignin, cellulose, and crude fiber, and among protein, ether extract, and acid-soluble ash. Significant negative correlations were found between any two constituents, if one belonged to the former group and the other to the latter group.

FERTILITY EVALUATIONS AND THEIR RELATIONSHIPS TO CLONAL PERFORMANCE AND COMBINING ABILITY IN ORCHARDGRASS, DACTYLIS GLOMERATA L.

By R. C. Leffel, R. R. Kalton, and C. E. Wasson. Agron. Jour. 46: 370-374. 1954.

Investigations involving 19 noninbred clones of orchardgrass concerned evaluations and interrelations of fertility, agronomic performance, and combining ability. Little or no evidence was found for an association between self-fertility and date of blooming, panicle production, forage yield, or seed yield of parental clones. Likewise, self-fertility of clones was not related to their combining ability as measured by single cross, polycross, and topcross performance for date of blooming, panicle production, or green forage yield. Relations between open pollinated, seed set, and parental performance or between open pollinated seed set and progeny performance were not definite enough to warrant emphasis.

COPPER COMPLEXES IN GRASSLAND HERBAGE

By C. F. Mills. Biochem. Jour. 57: 603-610. 1954.

Forage samples from both swayback and normal pastures were subjected to organic solvent extraction with a series of solvents of gradually increasing dielectric constant. The quantities of copper ex-

tracted by different solvents are compared and the results discussed.

The solubility of copper in the forage in water was investigated by the use of a dialysis procedure. The results indicate that rather less water-soluble copper is present in the swayback pastures than in normal forage.

Samples were extracted with dilute aqueous solutions of chelating agents. Seasonal variations in the solubility of forage copper were demonstrated particularly for the normal samples examined. The greater part of the copper in both the swayback and normal pastures appeared to be in a more stable form than the copper-glycine complex.

DEVELOPING CREEPING-ROOTED ALFALFA FOR PASTURE

By D. H. Heinrichs. *Canad. Jour. Agr. Sci.* 34: 269-280. 1954.

A breeding project was planned to develop a creeping-rooted, drought-resistant alfalfa variety for the dry-plains region of Canada. Strongly creeping-rooted lines were developed. The breeding work has been conducted on the basis of combining ability for the creeping-rooted character. Results of this phase of the project are presented along with some correlation coefficients between important characters. It was concluded that breeding for the creeping-rooted character on the basis of combining ability is sound since the character itself appears to be of a quantitative nature.

NUTRIENT STUDIES OF BRUSHLAND SOILS IN SOUTHERN CALIFORNIA

By J. Vlamis, E. C. Stone, and C. L. Young. *Soil Sci.* 78: 51-55. 1954.

Several soils were collected from an area with a chaparral cover in southern California. Some of these soils had a good cover, and others had a poor or scattered vegetation. Two horizons of soil were collected separately from each site. The samples were assayed for nitrogen, phosphate, and potash by means of a modified Mitscherlich pot-testing technique in a greenhouse. Lettuce was used as a test plant. These soils showed nitrogen and phosphate deficiencies, particularly in the second horizons. Only one soil showed a potash deficiency.

STUDIES OF GRAZING BEHAVIOUR IN RELATION TO GRASSLAND MANAGEMENT I. VARIATIONS IN GRAZING HABITS OF DAIRY CATTLE

By J. Hancock. *Jour. Agr. Sci.* 44: 420-433. 1954.

A series of grazing behaviour observations on 10 sets of lactating identical twins is described. Four fortnights distributed over the main lactation period were covered. In three of the fortnights, the observations were made on six 24-hour periods, while in the remaining fortnight the cows were observed on all 14 days. An outstanding feature of the grazing behaviour of dairy cattle is its variability, due to external and internal conditions. Of the external factors, climate (in a temperate zone) is relatively unimportant.

The quantity and quality of the herbage offered are of importance in modifying the grazing behaviour of dairy cattle. Under adverse pasture conditions there is, in general, an increase of total working time (grazing + ruminating): grazing time increases with scarcity of herbage and with mixed quality, while ruminating time is prolonged by poor quality grass.

COLD RESISTANCE AND CHEMICAL COMPOSITION IN OVERWINTERING ALFALFA, RED CLOVER, AND SWEET-CLOVER.

By R. J. Bula and D. Smith. *Agron. Jour.* 46: 397-401. 1954.

The cold resistance of the roots and crowns of spring-sown Ranger alfalfa, medium red clover, and biennial white sweetclover were measured from early fall to late spring in 1950-51 and in 1951-52. Analyses for total available carbohydrates were made during both seasons, and in addition, reducing sugars, total sugars, starch, total nitrogen, and total ash were determined during the 1950-51 season.

Although the trends in alfalfa and sweetclover were somewhat similar, cold resistance developed more rapidly during the fall and early winter in sweetclover, and reached a higher level than in alfalfa. Cold resistance in red clover developed later and more slowly than in alfalfa or sweetclover, and the maximum level was considerably less.

PERFORMANCE OF BIRDSFOOT TREFOIL ALONE AND IN COMPETITION WITH OTHER SPECIES IN PASTURES

By K. S. Yawalkar and A. R. Schmid.
Agron. Jour. 46: 407-411. 1954.

Two experiments were conducted to study the effect of growing birdsfoot trefoil alone and in combination with various grasses and legumes on total pasturage per acre and on the contribution of birdsfoot trefoil to total production as measured by botanical composition. The effect of an application of 400 pounds of 0-20-10 fertilizer per acre was determined on the basis of productivity and botanical and chemical composition of various pasture mixtures.

Highest pasturage yields were from the mixtures containing alfalfa. In a red clover-birdsfoot trefoil mixture, the clover suppressed the trefoil during the first production year and then disappeared due to its biennial nature. Birdsfoot trefoil was winter injured severely during 1951-52. The fertilizer application increased the productivity of all pasture mixtures at the 1-percent level of significance in 1951-52. Yields were increased consistently but the differences were not statistically significant. The fertilizer application increased the crude protein contents of all pasture mixtures in 1951 and 1952.

IMPROVED PASTURE FOR SPRING AND SUMMER, RANGE FOR FALL AND WINTER

By A. D. Miles; *Jour. Range Mgt.* 7: 149-152. 1954.

On a high foothills Montana ranch, improved pasture has eliminated larkspur losses and increased carrying capacity. Crested wheatgrass is used for spring pasture, the deep-rooted orchardgrass and alfalfa for summer forage. The cattle and sheep winter on the range no longer needed for summer grazing. They consume one-half as much hay wintered on the range as when wintered on hay alone.

A cow that will range out is recognized as desirable. Cows are being bred that will raise sizable calves and winter on available feeds. Sagebrush is being controlled by the development of improved pasture and by maintaining the range in good condition. Phosphates and nitrates are recognized as constituents of organic matter, and it is believed they can be supplied cheaply by deep-rooted legumes.

A VARIATION OF DEFERRED ROTATION GRAZING FOR USE UNDER SOUTHWEST RANGE CONDITIONS

By L. B. Merrill. *Jour. Range Mgt.* 7: 152-154. 1954.

The results of a deferred rotation system of grazing are presented. The rotation system used is simple in application, since it is necessary to move only one group of livestock every 4 months. Under this system each pasture is grazed 12 months and rested 4 months. The rest period comes at a different time of the year in each rotation cycle. No definite advantage in livestock gains has been found on deferred rotation pastures as compared with those grazed year-long at the same stocking rate. However, the vegetation on the rotation pastures is obviously improving more than that on the year-long grazed areas. There is, therefore, a steady trend toward improved range conditions as well as increased financial returns on these pastures.

EFFECTS OF GRAZING ON THE SOILS AND FORAGE OF MIXED PRAIRIE IN SOUTHWESTERN SASKATCHEWAN

By R. W. Lodge. *Jour. Range Mgt.* 7:166-170. 1954.

The effects of heavy grazing on chemical and structural conditions in the soil and on the phosphorus and protein content of forage were evaluated in a study in the mixed prairie in southwestern Saskatchewan. Forage analyses in the late leaf stage and soil analyses were conducted on grazed and ungrazed treatments on four sites. Forage constituents were separated into needlegrasses, wheatgrasses, and other forage for chemical analyses. Soils were analyzed for texture, volume weight, percent moisture, pH, moisture equivalent, organic-matter content, total nitrogen, and available phosphorus.

Forage analyses showed that ether extract, crude fiber, and ash were higher and protein, nitrogen-free-extract, calcium, and phosphorus were lower on the ungrazed treatments as compared to the grazed areas in all classes of forage. Differences in protein between grazed and ungrazed treatments were most significant.

Changes in the availability of phosphorus in the soils studied apparently occurred due to grazing but were influenced by soil-moisture conditions. On sites of low moisture content, available phosphorus tended

to increase under grazing. The single site with more favorable moisture conditions showed diminished available phosphorus under grazing. The reactions to grazing of the vegetation of mixed-grass prairie were modified by differences in site characteristics.

ECONOMIC CRITERIA FOR DETERMINING OPTIMUM USE OF SUMMER RANGE BY SHEEP AND CATTLE

By J. A. Hopkin. Jour. Range Mgt. 7: 170-175. 1954.

The optimum combination of sheep and cattle on a given range is obtained by equating two independent functions: (1) the physical enterprise relation (the iso-resource curve) which shows the combinations of sheep and cattle that can be grazed on a given range without injury to the plant species, and (2) the price relations (the iso-revenue line). From the standpoint of "proper" range stocking, every alternative along the iso-resource curve is equally acceptable. If the costs of producing a "unit of product" are not substantially different for the two enterprises, the iso-revenue line can be determined from market prices; otherwise additional considerations must be given.

The suggested analytical model was applied to some very interesting data presented by Cook in a noteworthy contribution to the science of range management. The discussion has been directed toward a refinement of the method so that it might be amenable to economic analysis and thus useful in making decisions pertaining to the combination of sheep and cattle on a given range site.

SOME INTERRELATIONS OF THE MERRIAM KANGAROO RAT TO VELVET MESQUITE

By H. G. Reynolds. Jour. Range Mgt. 7: 176-180. 1954.

Some of the interrelations of velvet mesquite and Merriam kangaroo rats were investigated on the Santa Rita Experimental Range near Tucson, Ariz. Velvet mesquite seeds are known to be buried in surface caches by kangaroo rats. These caches produce enough seedlings in spite of drought or other mortality factors to effect mesquite spread and increase.

By inference from home range studies and measurements of seed transport, Merriam kangaroo rats were capable of moving mesquite seed less than 200 feet on the average. On this basis and accounting for time required for mesquite trees to fruit, kangaroo rats could spread a mesquite border about 1 mile in about 500 years.

On a sample plot, 70 percent of the kangaroo rat burrows were located beneath mesquite trees and 99 percent of the trees were occupied by burrows. The trees further improve the habitat for rats by competing with and reducing perennial grass density which interferes with escape of rats from predators.

Mesquite and rats apparently have no dependency relation. Heavy populations of mesquite occurred where there were no rats and vice versa. Cattle apparently are a more important biotic agency than kangaroo rats for mesquite seed dissemination. Among other biotic agencies of dispersal are the deer, peccary, cottontail rabbit, jack-rabbit, and coyote. Once mesquite is established and the habitat is favorable for kangaroo rats, these rodents may help to thicken the stand.

Once the cycle: more mesquite--less perennial grass--more rats--more mesquite-- is initiated because of the effect of other dispersal agencies or the suppression of factors which may prevent the increase of mesquite, the rate of mesquite is not likely to be retarded appreciably by removing Merriam kangaroo rats.

REACTION OF SOME GRASSES TO ARTIFICIAL SALINIZATION

By H. W. Gausman, W. R. Cowley, and J. H. Barton. Agron. Jour. 46: 412-414. 1954.

The tolerance of five grasses to applications of irrigation water salinized with different quantities of CaCl_2 or NaCl_2 was investigated. The tolerance of the grasses to artificial salinization in decreasing order was: Rhodes, Coastal Bermuda, blue panicum, buffel, and Angleton. Treatments with salinized water significantly affected the phosphoric acid content of some grasses. The reduction in the phosphoric acid content of Angleton was especially significant.

Salinization with NaCl and CaCl_2 increased the sodium content of Coastal

Bermuda and decreased the sodium content of Angleton and Rhodes grass. The elemental composition of the top growth of buffel, Coastal Bermuda, and blue panicum was generally not associated with the salinization levels.

Tree fruits and nuts

RELATION OF POTASH AND PHOSPHATE TO COLD INJURY OF MOORE PECANS

By R. H. Sharpe, G. H. Blackmon, and Nathan Gammon, Jr. *Better Crops with Plant Food*. 38: 17-18. 1954.

Reducing winter injury to Moore pecan trees resulted from potash fertilization under conditions of low potassium supply. No important relation to previous superphosphate treatment was indicated. Data on leaf composition showed potassium in the foliage was related to treatment and to extent of injury. Foliage injury from aphids and scab and late growth maturity were factors predisposing the trees to injury.

Vegetable Crops

INFLUENCE OF NITROGEN, PHOSPHORUS AND POTASSIUM ON THE YIELD OF SWEET POTATOES ON HOCKLEY FINE SANDY LOAM SOIL

By J. M. Coruthers and D. R. Paterson. *Tex. Agr. Expt. Sta. Prog. Rpt.* 1646. 1954.

A significant increase in yield of sweet-potato roots resulted as the rate of phosphoric acid was increased from 0 to 40 pounds per acre. There also was a significant increase in the total yield of roots with each additional increase in potash. The 40-pound rate of phosphoric acid and the 60-pound rate of potash also gave the highest yield of marketable roots per acre. There was no measurable response to the various levels of nitrogen.

FUNGICIDES FOR THE CONTROL OF DAMPING-OFF IN TOMATOES

By M. C. Strong. *Mich. Agr. Expt. Sta. Quart. Bul.* 36: 285-290. 1954.

This study evaluated some of the newer fungicides for the control of damping-off. The chemicals were applied in three differ-

ent ways--as dust treatments of seed before sowing, soil treatments before sowing, and sprinkler treatments after sowing.

All dust treatments tested effected good control of damping-off in tomato seedlings with the exception of Manzate. However, when used as a soil treatment, Manzate offered good damping-off control. Captan produced burning of the tips and edges of the leaves from all three types of application. Least injury was produced by the dust treatment. With the exception of Manzate, all of the fungicides tested both as soil treatments and dusts were just as effective in the latter type of application. The sprinkler treatments tested seemed to be unreliable for the control of damping-off.

Cuprocide, orthocide, Crag 658, TMTD (75 percent), Arasan (50 percent), Tersan (50 percent), and Mathieson 275 were the other fungicides tested.

RESPONSE OF BEANS (*Phaseolus vulgaris* L.) TO INOCULATION WITH MIXTURES OF EFFECTIVE AND INEFFECTIVE RHIZOBIA

By J. C. Burton, O. N. Allen, and K. C. Berger. *Soil Sci. Soc. Amer. Proc.* 18: 156-159. 1954.

This study was to determine the plant-growth response of beans to effective and ineffective rhizobia applied at different time intervals. Precedence in the addition of the different inocula and time of harvest were also employed as major variables.

Beans receiving both effective and ineffective rhizobia simultaneously made as good growth and fixed as much nitrogen as did those which received only effective strains at planting or 21 days later. Plant response to the inoculation treatments was not different at the 35-, 45-, and 68-day harvests.

Plants bearing ineffective nodules and nodule-free plants of the same age were equally susceptible to nodulation by effective rhizobia added at the 21-day period. Ineffective rhizobia added to 21-day old plants bearing effective nodules had no adverse effect on growth or on nitrogen content of these plants.

The amount of nitrogen in the bean nodules examined was related to the kind of inoculum applied. Effective nodules contained 6-8-percent nitrogen, ineffective ones averaged 3-4-percent nitrogen, and those from plants treated with mixed inocula showed a range of 5-8-percent nitrogen.

THE INFLUENCE OF CERTAIN FERTILIZING MATERIALS ON THE SOIL REACTION AND NUTRIENT LEVEL IN THE POTATO ROW DURING THE GROWING SEASON

By E. M. Dunton, Jr., R. B. Hall, and M. E. Taylor. Soil Sci. Soc. Amer. Proc. 18: 47-53. 1954.

This study was to determine whether fertilizer materials might differ in their influence on the soil reaction, with some possibly being more effective than others in reducing the pH of soils where there was danger of scab.

A commercial 5-10-5 fertilizer was used for treatment 1, and handmixed materials were used for the other 5 treatments. In treatment 2, all the nitrogen was derived from NH_4NO_3 , while in treatment 3, it was derived from $(\text{NH}_4)_2\text{SO}_4$. In treatments 4 and 5 the nitrogen was derived from NH_4NO_3 , and 50 and 100 pounds of sulfur, respectively, were added per ton of fertilizer. All of the treatments were applied at the rate of 2,000 pounds per acre except treatment 6 where the fertilizer mixture was applied at the rate of 3,000 pounds per acre.

The 6 fertilizer mixtures markedly lowered the soil reaction in the potato row during the 1949 and 1950 growing seasons. This influence varied with the sampling location or position of the soil sample with respect to the fertilizer bands, with the greatest influence being exerted above the bands. The lowering of the pH was associated with increases in salt concentration in nitrates and in potassium. There was no important differences in the influence of the 6 different mixtures on the soil acidity except where the soil samples were taken from the fertilizer bands.

THE EFFECT OF MINERAL NUTRITION ON THE EXPRESSION OF POTATO LEAF ROLL VIRUS SYMPTOMS

By C. S. Hoveland, K. C. Berger, and H. M. Darling. Soil Sci. Soc. Amer. Proc. 18: 53-55. 1954.

Some mineral-deficiency symptoms and those of the leaf-roll virus have frequently been confused. The similarity between mineral deficiencies and leaf-roll symptoms suggests that the effect of the virus might be influenced by the nutrition of its host. A study of certain mineral relations

between healthy and diseased leaf-roll plants in the Chippewa variety was therefore undertaken.

Greenhouse and field experiments indicated phosphorus deficiency produced symptoms ranging from slight to severe rolling of the leaves and from light to heavy pigment formation as the amount of phosphorus decreased. Symptoms of extreme phosphorus deficiency in nonvirus plants were similar to those produced by the virus except that more pigmentation occurred in the phosphorus-deficiency symptoms. Severe nitrogen and slight phosphorus deficiencies caused only a moderate increase in the intensity of leaf-roll symptoms while calcium, potassium, magnesium, and sulfur had little or no effect. Leaf-roll symptoms tended to be masked with adequate balanced nutrition.

SALT TOLERANCE OF FIVE VARIETIES OF ONIONS.

By L. Bernstein and A. D. Ayers. Amer. Soc. for Horticultural Sci., Proc. 62: 367-370. 1953.

Five commercially important varieties of onions were grown on a series of artificially salinized plots. The salt tolerance of onions grown as a spring crop at Riverside is low, a 50-percent decrease in yield occurring at an EC_e value of 4.1 millimhos/cm. With the exception of Texas Early Grano, which was somewhat more salt-sensitive, the salt tolerance of the five varieties did not differ appreciably. Mineral analysis of bulb tissue confirms the similarity in response to salinity of the five varieties. Salinity had only a slight effect on the sugar content of bulb tissue.

Weed, brush, and pest control

THE EFFECTS OF 2,4-D SPRAY DRIFT ON SWEET CLOVER PLANTS IN THE SECOND YEAR OF GROWTH

By J. E. R. Greenshields and W. J. White. Canad. Jour. Agr. Sci. 34: 389-392. 1954.

The effects of drift spray 2,4-D butyl ester at 6 ounces per acre were sublethal but resulted in shedding leaves, distortion of leaves and stems, and shedding of flowers. Effects decreased with distance but were clearly discernible at 96 rods. Fifty-one days after treatment the seed yield per plot in grams was 25.1 for the

check, 2.3 for plants adjacent to, and 18.9 for plants 96 rods from the sprayed area. Seed quality decreased with proximity to the sprayed area. In a supplementary test residual 2,4-D in spraying equipment reduced seed yield 50 percent. Low seed yields in recent years may be attributed in part at least to the above demonstrated effects.

FALL APPLICATIONS OF IPC AND CIPC FOR KILLING WILD OATS (ARENA FUTUA) PRIOR TO SOWING OATS

By A. F. Wiese and R. S. Dunham. Agron. Jour. 46: 358-360. 1954.

Fall treatments of IPC and CIPC for selective control of wild oats in the spring were not successful in that treatments not toxic to oats at sowing time only partly controlled wild oats. Wild oats were eliminated only on treatments where CIPC and IPC were very toxic to cultivated oats sown in the spring.

COMPANION CROPS FOR WEED CONTROL IN SOYBEANS

By R. G. Robinson and R. S. Dunham. Agron. Jour. 46: 278-281. 1954.

A new practice in soybean production--the use of companion crop competition for weed control--is described. Soybeans sown with a grain drill in noncultivated rows 6 inches apart and with winter wheat or winter rye as companion crops yielded as much or more than soybeans without companion crops whether in noncultivated rows 6 inches apart or in cultivated rows 40 inches apart. Weed control with companion crops was much superior to no companion crop in noncultivated soybeans, and was about equal to that achieved by cultivation. The expense of this weed-control practice is relatively small, only 1 bushel per acre of farm grown winter wheat or winter rye seed is required. The new practice is also good soil conservation compared to usual methods of soybean production. Winter vetch, alfalfa, medium red clover, brome grass, or timothy companion crops did not give satisfactory weed control. Field peas as a companion crop resulted in soybean lodging.

In cultivated soybeans grown in rows 40 inches apart, companion crops sown in the

soybean row did not add much, if any, weed control to that achieved by the cultivation. However this practice may be of interest to seed producers of small-seeded legumes and grasses and to farmers who wish to cultivate soybeans or corn in erosive areas.

AMOUNT OF SPRAY PER ACRE FOR THE CONTROL OF COTTON BOLL WEEVILS AND BOLLWORMS

By E. C. Brown, Jr., and R. L. Hanna. Tex. Agr. Expt. Sta. Prog. Rpt. 1687. 1954.

Tests were conducted during 1950-53 to compare the effectiveness of three different quantities of liquid spray per acre for the control of cotton boll weevils and bollworms. An equal amount of active insecticide ingredient was applied to all test plots with three spray nozzles per row. Two gallons of spray per acre controlled these insects as well as 6 or 14 gallons, as measured by both yields and insect infestation. Spraying cotton plants at 2 gallons per acre is more economical than applying spray at the higher rates because of the time and labor saved in handling a smaller quantity of water.

BOLLWORM CONTROL IN COTTON DURING 1953

By D. F. Martin, W. J. Mistic, Jr., and J. K. Walker, Jr. Tex. Agr. Expt. Sta. Prog. Rpt. 1697. 1954.

DDT applied every 5 days at the rate of 1.5 pounds active ingredient per acre resulted in significantly better bollworm control and a greater yield of cotton than did the same amount of DDT applied at 7- or 10-day intervals or 0.75 pound of DDT per acre applied every 5 or 7 days. Significantly better bollworm control and greater yields were obtained in all treatments than in the untreated check.

Significantly better bollworm control was obtained when toxapene-DDT or diel-drin-DDT were applied every 4 days than every 8 days. These materials when applied every 4 days were more effective than aldrin-DDT every 4 days. Applications of aldrin-DDT applied at 4- and 8-day intervals were equally effective. All materials were about equally effective when applied every 8 days.

GROWERS TRIALS FOR CONTROL OF WIREWORMS ATTACKING CORN

By W. M. Kulash. Jour. Econ. Ent. 47: 863-866. 1954.

Results of three grower trials with different insecticides applied by different methods for the control of wireworms attacking corn in muck-type soil in eastern North Carolina indicated the following: Heptachlor as a soil treatment was more effective than heptachlor-treated seed planted in untreated soil. A combination treatment of treated seed and treated soil was not much more effective than treated soil alone.

Seed treatments with aldrin, dieldrin, or heptachlor appeared more effective than lindane or a mixture of lindane with a fungicide, 50 percent n-trichloro-methylthio tetrahydrophthalimide.

Spraying in the drill row with aldrin, dieldrin, or heptachlor afforded some protection against wireworm attack, but lindane used in this manner was not effective.

CULTIVATION AND CHEMICAL WEED CONTROL IN POTATOES

By R. J. Aldrich, G. R. Blake, and J. C. Campbell. N. J. Agr. Expt. Sta. Agr. 36: 8-11. 1954.

Weeds were effectively controlled on potato land by use of chemicals of the denitro-o-sec. butyphenol type without injuring potatoes when the chemicals were applied before the potatoes emerged. The use of the chemical weedkillers also increased the yields of potatoes. Three to 4.5 pounds of active material per acre were needed. Twenty to 40 gallons of water per acre were satisfactory.

CHEMICAL CONTROL OF CHEROKEE ROSE, ALDER AND CERTAIN OTHER PASTURE WEEDS

By V. S. Searcy. Ala. Agr. Expt. Sta. Leaf. 43. 1954.

The most practical and economical method of controlling a heavy infestation of Cherokee rose is : (1) Remove top growth of roses with a rotary type mower; (2) when the new growth of roses reaches a length of 12-18 inches, apply 2 pounds (acid equivalent) of an annine form of 2,4-D per acre or 1 pound of the low volatile ester.

Repeat the chemical treatment as often as the new growth of roses reaches the above length. Alder can be controlled during the dormant season by applying 2,4,5-T in diesel fuel to the bottom 18-24 inches of the stems until thoroughly wet. Mix the 2,4,5-T with diesel fuel at the rate of 8 pounds (acid equivalent) per 100 gallons of fuel.

GERMINATION OF WEED SEEDS: III. THE INFLUENCE OF CROPS AND FALLOW ON THE WEED SEED POPULATION OF THE SOIL.

By A. C. Budd, W. S. Chepil, and J. L. Doughty. Canad. Jour. Agr. Sci. 34: 18-27. 1954.

Information is presented showing the relative influence of crops and fallow on the number of annual weed seeds in the soil under semiarid conditions of southwestern Saskatchewan. Soil samples were collected in the spring and fall from each strip of a field in a 3-year rotation of fallow-wheat-wheat. The number of viable seeds was counted for 6 years, the same locations being sampled each time. The data show a reduction in total viable seeds from spring to fall when the land was fallowed. There was an increase in viable seeds from spring to fall in the cropped land each year, except one. In general, there was a reduction in viable seeds during the over-winter period. Summer fallowing was most effective in controlling weeds whose seeds have a short period of dormancy. As climatic conditions influenced weed development, the weed-seed populations varied in kind and number from year to year. At all times during the experiment there were sufficient weed seeds in the soil to produce a dense weed cover.

CHEMICAL CONTROL OF DOWNY BROME-GRASS (BROMUS TECTORUM L.) IN AN ESTABLISHED ALFALFA FIELD

By M. G. Wiltse and B. R. Churchill. Agron. Jour. 46: 160-162. 1954.

The chemical control of downy brome-grass in an established alfalfa field was attempted by applying IPC and TCA. Four different experiments were conducted to help determine rate and time of year to apply the herbicides for best control.

TCA controlled downy brome-grass best when applied prior to germination. TCA at 9 pounds per acre reduced the total dry weight and the dry weight per plant of

downy brome grass more than half that amount.

TCA and IPC applied in the fall controlled downy brome grass better than the spring applications. TCA at 18 pounds per acre applied in the fall gave excellent control of downy brome grass.

IPC at 2.5 pounds per acre applied in the fall, and 5 and 10 pounds per acre applied in either the fall or spring gave excellent control of downy brome grass. Spring applications of the herbicides significantly decreased the alfalfa yields when compared with fall applications. Alfalfa injury was observed when IPC and TCA were applied at 10 and 18 pounds per acre, respectively. Spring applications of IPC stunted the downy brome grass but did not prevent seed formation.

HOW TO CONTROL OUR TEN WORST WEEDS

Anonymous. Country Gentleman. 124: 40-41. 1954.

Canadian thistle--Spray 2, 4-D at bud stage and when rosettes form on regrowth for at least 2 years. Use 1/2-1 pound per acre. MCP is effective too, as is sodium chlorate used at 4-5 pounds per square rod. Clean cultivation after harvest stops fall regrowth in grain fields. Crab grass--for lawns, spray PMA three times at 10-day intervals, starting at germination. Use 2 ounces (10 percent material) per 1,000 square feet in water. For corn use pre-emergence spray of 2, 4-D ester, 1-1/2 to 3 pounds per acre.

Field bindweed.--Repeated sprays applied in bud to bloom stage are effective killers. Use 1/2-1 pound per acre of 2, 4-D. For small patches, try soil sterilants such as 4-6 pounds per square rod of sodium chlorate. Heavy cultivations followed by soybean or sorghum smother crop works too. Seed is viable 30 years, so you can't expect a one-season cleanup.

Giant foxtail.--Try pre-emergence sprays of 2, 4-D at 1-1/2 to 2 pounds in 10 gallons of water. Winter wheat, fallowed cultivation, stops seed formation. Cross-cultivation and close grazing help. These practices are effective on common foxtail.

Horse nettle.--Spray between bud and fruit-setting stages. Use 2, 4, 5-T at 1 pound per acre. Mowing to stop seed formation helps too. Combine punches by clipping at full bloom then spraying with 2, 4, 5-T when regrowth is 4 to 6 inches.

Plow after grain, then summer-fallow 2 years for cultural control.

Johnson grass.--TCA and sodium chlorate are effective chemical controls. Use TCA at 3/8 to 5/8 pound, and sodium chlorate at 4 to 6 pounds per square rod. Since these rather large amounts are costly, you may prefer clean cultivation. Start in May and prevent growth for rest of season. Heavy pasturing and frequent clipping limit stands.

Perennial sow thistle.--Carefully timed sprayings are effective. Apply 1/2-1 pound per acre of 2, 4-D amine or ester just before development of flower. More than one spray is needed for complete kill. Two or three years of fallow or persistent working with wheat are needed for cultural control.

Quackgrass.--TCA, sodium chlorate and CMU kill quackgrass but repeated cultivation that lifts roots to surface is cheapest. Apply TCA in summer or fall at 80-100 pounds per acre; cut rate to 25-70 pounds where tillage also is used. Sodium chlorate works at 3-5 pounds per square rod. Use CMU on noncropland at 20-50 pounds per acre.

Ragweed.--Spray pastures with 2/3 to 1 pound per acre of 2, 4-D amine before pollination. Pre- and post-emergence corn sprays kill ragweed. When grains are 6-10 inches and tillered, apply 2, 4-D or MCP at 1/4 to 1/2 pound.

Wild mustard.--This grain-field weed can be chemically controlled, but under-seeded legumes complicate the job. Use 2, 4-D or MCP at 1/4 to 1/2 pound per acre when cereals are 6-10 inches and fully tillered. Use only amines if legumes are present and allow a canopy of growth to develop, or spray DNOSBP amine at 3/4 to 1 pound per acre in 30 to 50 gallons of water.

PRE-EMERGENCE SPRAYS FOR THE CONTROL OF WEEDS IN COTTON IN THE EL PASO VALLEY, 1953

By P. J. Lyerly, P. D. Christensen, and L. S. Stith. Tex. Agr. Expt. Sta. Prog. Rpt. 1665. 1954.

Preliminary observations indicate that pre-emergence sprays offer some promise for control of weeds in cotton in the El Paso area. The herbicides, as applied, were effective against germinating annual weeds only and were not effective in the control of perennial weeds, such as bind-

weed, Johnson grass, and nutgrass. The application of weedicides as reported here is a precision operation. Severe injury to cotton has been reported at other locations under some conditions from the use of each of the chemicals listed. Farmers wishing to use these materials are urged to try only a limited acreage until further information is obtained.

STUDIES IN SELECTIVE WEED CONTROL: V. THE CONTROL OF WEEDS IN LIN- SEED BY CHLORINATED PHENOXYACE- TIC ACIDS

By K. Holly and G. E. Blackman. Jour. Agr. Sci. 44: 173-183. 1954.

Between 1946 and 1950 multifractional field experiments were carried out to determine the potentialities and effectiveness of chlorinated phenoxyacetic acids for the selective control of weeds in flax. The initial experiments in 1946 demonstrated that treatment with sodium 2-methyl-4-chlorophenoxyacetic led to considerable increases in the yield of seed through a reduction of the weed population and the consequent decrease in weed competition.

The subsequent experiments were undertaken on relatively weed-free crops so that the direct effects on the crop of compound, formulation, and stage of growth at the time of application could be investigated along with differences in varietal response.

Varieties varied in degree of resistance to these chlorinated phenoxyacetic acids and of the varieties tested Minerva was the most susceptible. There was some evidence that resistance or susceptibility is an inheritable characteristic.

DELAYED KILL OF INTERIOR LIVE OAK BY FALL TREATMENT WITH 2, 4-D AND 2, 4, 5-T

By W. E. Emrick and O. A. Leonard. Jour. Range Mgt. 7: 75-76. 1954.

Foliage spray applications of 2, 4-D amine in solutions containing 2 pounds of acid equivalent per 100 gallons of water were more effective in the control of 1-year-old sprouts of interior live oak than comparable rates of 2, 4-D ester, 2, 4, 5-T amine, and 2, 4, 5-T ester.

Death of most of the sprout clumps treated with 2, 4-D amine occurred between 2 and 3 years following treatment. This

delayed kill was much less pronounced for the other herbicidal treatments, and has not been previously observed on live oak.

THE BRUSH PROBLEM IN CALIFORNIA

By H. H. Biswell. Jour. Range Mgt. 7: 57-62. 1954.

Benefits from brush removal and manipulation are an increase in forage production, an increase in wildlife populations, and a decrease in fire hazard. Removal of brush has resulted in variable effects on the flow of springs.

Methods of brush removal include controlled burning, bulldozing, and chemicals, application of herbicides, and combinations of these. Usually a combination of methods works best. Other important and essential steps in brush removal are reseeding and grazing management.

TWO-YEAR PROGRESS REPORT ON WEED CONTROL IN PEANUTS

By J. T. Thompson, E. W. Hauser, and S. V. Stacy. Ga. Agr. Expt. Sta. Press Bul. 650. 1954.

Eight chemicals were tested in 1952 to evaluate their effectiveness for controlling weeds in peanuts. Three treatments promoted increases in yield of peanuts. In 1953, peanuts treated with Crag 1 at 2 and 4 pounds and Premerge at 12 pounds per acre produced significantly better yields than the check or other chemical treatments. Damage to the roots at seedling stage was noted following the application of chemicals, especially at the high rates; Crag 1 gave little or no damage at the lowest rate and only moderate injury at higher rates.

CHEMICAL WEED CONTROL IN COTTON

By J. T. Thompson, E. W. Hauser, S. V. Stacy, and J. G. Futral. Ga. Agr. Expt. Sta. Press Bul. 649. 1954.

CIPC, CMU and DNOSBP were tested for weed control in cotton in six tests on all major soil types in Georgia during 1953. DNOSBP appears to be too toxic for use (under some conditions in Georgia) for pre-emergence weed control in cotton, particularly at the 12-pound rate. CMU did not give satisfactory weed control on the sandier soils of the Coastal Plain. In the Pied-

mont and Limestone Valley sections, good weed control was obtained. CIPC was effective for longer periods of time than the other chemicals used. It apparently does not leach from the soil as easily as the other chemicals. However, CIPC does not control ragweed and coffee weed nearly as well as CMU. At Experiment, application of CIPC at 6 and 9 pounds and CMU at 1-1/2 and 2 pounds, resulted in yields not significantly different from the hoed checks. At Athens there was no significant yield difference.

POISONING VERSUS GIRDLING TO RELEASE UNDERPLANTED PINES IN NORTH MISSISSIPPI

By B. J. Huckenphaler. Jour. Forestry. 52: 266-268. 1954.

Undesirable overstory hardwoods, principally blackjack, post, red, and black oaks and hickories were treated by frill girdling and by the ammate-in-notch system of poisoning to release 8-year-old underplanted pine. The principal findings were:

Single-hack frill girdling gave a more complete crown kill on upland oaks and hickories and cost less, but was slower in killing than ammate poisoning. Ammate poisoning was more effective in preventing sprouting than was frill girdling or felling without application of ammate. With or without applications of ammate, small trees sprouted much more prolifically than large trees.

During the 2 years following treatment, released pines outgrew those not released. Differences in the average growth of all pines between poisoned and frill-girdled plots was not statistically significant. Almost one-tenth of the underplanted pines were killed or severely damaged by falling stems or branches of deadened trees. This heavy damage is believed largely due to the 8-year delay in release.

TESTS OF AERIAL APPLICATIONS OF HERBICIDES ON POST OAK AND BLACK JACK BRUSH IN OKLAHOMA: PROGRESS REPORT, 1952-1953

By H. M. Elwell and W. C. Elder. Okla. Agr. Expt. Sta. Cir. M-258. 1954.

The post oak-blackjack type of brush has been controlled and productive pastures developed where herbicides of the low vola-

tile esters were properly applied. The most satisfactory results were obtained with 2,4,5-T. The rate of application for the initial treatment was 2 pounds of acid in 5 gallons of spray solution per acre in flight swaths of 33 feet. Spray solutions consisting of oil and water emulsions settled immediately on the leaves and twigs of the brush and did not drift as readily as oil solutions.

For effective control, however, retreatments of 1 to 2 pounds per acre were necessary. It was usually best to retreat the first year after the initial applications. Other retreatments will depend upon the amount of competition from the remaining brush. About the same degree of effectiveness was also obtained in similar treatments using a mixture consisting of equal parts of 2,4-D and 2,4,5-T applied at the rate of 3 pounds per acre.

The most satisfactory time to spray is when the plants have just developed full leaf size, the soil moisture is ideal for growing conditions, and there is little or no wind but fairly high humidity. Full grass production will be obtained more rapidly, and erosion more completely controlled, if sites are selected on deep fertile soil which has only light to medium brush coverage. The grass cover is more dense on areas where the shade from the woody vegetation is less. Under such conditions, a complete cover of grass is usually established in 1 to 2 years.

FORESTRY, WOODLOTS, SHELTERBELTS

EFFECT OF A HARDWOOD FOREST CANOPY ON RAINFALL INTENSITIES

By G. R. Trimble, Jr., and S. Weitzman. Amer. Geophys. Union Trans. 35: 226-236. 1954.

Ground rainfall intensities and throughfall were measured under a fully stocked hardwood forest in West Virginia for 1 year. Maximum 5- and 15-minute intensities were compared with similar measurements made in the open. The results were analyzed separately for winter and summer conditions; that is, bare canopy versus canopy in full leaf. Regression equations were calculated for estimating intensities and throughfall under canopy from rainfall measurements made in the open. The study shows that low rainfall intensities are reduced more by summer canopy, and high intensities are reduced more by winter canopy. Throughfall is reduced by canopy

interception approximately the same amount in both summer and winter.

ESTIMATING THE QUANTITY OF TREE FOLIAGE IN OAK STANDS IN THE TENNESSEE VALLEY

By J. S. Rothacher, F. E. Blow, and S. M. Potts. *Jour. Forestry*. 50: 169-173. 1954.

An effective technique was developed for estimating the quantity of foliage in mixed oak stands in the Tennessee Valley. Leaf measurements collected at three stages of growth in 2 successive years showed that on the sample acre both leaf area and leaf weight varied significantly, but that number of leaves was constant. Estimating equations for number of leaves by diameter of both tree and branch were developed for several hardwoods and shortleaf pine. Those for white, black, and scarlet oaks have been validated in oak stands in five localities. The stand table for a forest area and a similar tally of branch sizes for the tree provide a framework for these estimating equations. They can be used, together with average leaf data, to give foliage area or weight for a forest stand as well as a single tree.

In a sample acre of mixed oak forest, with a basal area of 60 square feet, seasonal variation in foliage area (transpiring surface) ranged from 4.3 to 5.2 acres. Foliage weight (oven-dry) ranged from 1.3 to 1.7 tons per acre.

FORAGE PRODUCTION IN OAK WOODLAND AS INFLUENCED BY REMOVAL OF TREE COVER

By P. T. Koshi, R. A. Darrow, and W. G. McCully. *Tex. Agr. Expt. Sta. Prog. Rpt.* 1661. 1954.

Tree removal in oak woodland increased forage production in proportion to the amount of overstory deadened. On an area with a good initial stand of desirable forage plants, yields of forage following reduction to a 13-percent canopy were five times greater than those on untreated check areas. The amount of forage eaten by cattle was proportional to the amount of overstory deadened. This selective grazing emphasizes the importance of controlling brush over an entire pasture to prevent concentration of grazing animals in cleared areas. Costs of complete removal by deadening with 2,4,5-T were \$27.23 per acre of

which approximately one-half was for materials. The increased forage production, assuming the use of 50 percent of the total produced as hay valued at \$25 per ton, would pay the total treatment cost in less than 5 years.

FOREST SOILS-SITE INDEX STUDIES IN MAINE

By H. E. Young. *Soil Sci. Soc. Amer. Proc.* 18: 85-87. 1954.

The field, laboratory, and analysis technique employed by Coile and his students in forest soils-site index studies in the South have been tried on a modest scale in Maine. A White Pine study based on 16 plots located in 16 different White Pine stands in the vicinity of Orono, Maine, yielded a regression equation which correlated site index with the depth of the A horizon and the percentage of stones in the B horizon. As both of these factors increase, the site index decreases. This was field checked in a series of White Pine stands within a 50-mile radius of Orono and in the southern part of the State along the Maine Turnpike. Data were also collected on 16 plots in spruce-fir stands on the Penobscot Experimental Forest, and this yielded a regression equation correlating the site index of spruce with the depth of the A horizon and the imbibitional water value of the A horizon. As both of these increase, the site index for spruce decreases. It is apparent that Coile's methods apply in Maine. Further study based on many more plots and covering a wider range of conditions are essential to obtain equations that can be used in practical forest management.

GRAZING LONGLEAF-SLASH PINE FORESTS

By W. O. Shepherd, B. L. Southwell, and J. W. Stevenson. *U. S. Dept. Agr. Cir.* 928. 1953.

To investigate possibilities for improving range-cattle production and thereby making more effective use of the forest-range resource in such areas, the grazing habits and year-long performance of breeding herds were studied for 5 years. Four fall and winter feeding management procedures were also studied. This report describes the study and presents the results.

Close observation of the grazing animals revealed that their range diet in the spring consisted mainly of two grasses, pineland threeawn and Curtiss dropseed. Bluestem grasses, Curtiss dropseed, carpetgrass, Florida dropseed, and toothache-grass were important during summer and fall. Curtiss dropseed was the species used during the winter. Chemical analyses indicated that the range forage was deficient in protein and minerals most of the year. Only in March did the protein content satisfy the estimated requirements for growing animals or lactating cows. Special measures were required to induce the cows to eat enough mineral supplement to keep blood phosphorus above the critical level after midsummer when they were suckling calves.

GROWTH AND MORTALITY IN AN OLD-FIELD SOUTHERN PINE STAND

By S. Guttenberg. Jour. Forestry. 50: 166-168. 1954.

This article compares the effects of several cutting treatments in a dense old-field stand of loblolly and shortleaf pine. It demonstrates that such stands are capable of good response, even when they are well past the age at which the first thinning for sawlog production should be made.

GROWTH VERSUS ALLOWABLE CUT

By P. C. Guilkey. Jour. Forestry. 52: 247-259. 1954.

A useful expression in evaluating the forest situation locally is an allowable cut which indicates the annual cut of merchantable timber that may be maintained while building toward a desirable level of growing stock and effecting a reasonably even distribution of size classes during the rotation selected for each type.

The traditional growth-drain relation has limitations in appraising the forest situation nationally, and it can be very misleading in local surveys. Growth consistently overestimates the desirable cut in young stands, and consistently underestimates it in old stands. It is practicable to make direct estimates of the allowable cut for the next decade on areas being covered by forest surveys. The estimate of allowable cut can be built up along the inventory and based upon the present conditions of the stands, ease of logging, the desirable

growing stock levels, the estimated growth, and the local objective of management.

A method in the Lake States for determining the allowable cut provides for progress toward a goal of sustained yield, taking into account the silvicultural and economic aspects of local management and provides a fairly detailed estimate of the area and volume to be cut in the next decade. This system has been used successfully on national forests in Region 9 and on county forests in Minnesota in setting a cutting budget and in selecting areas to be put up for timber sale.

HOW TO GROW LONGLEAF PINE

By H. H. Muntz. U. S. Dept. Agr. Farmers' Bul. 2061. 1954.

Longleaf pine can be profitably grown as a forest crop on farms as well as on large industrial holdings throughout much of the Southern Coastal Plain. The tree is able to grow well even on poor sandy soils, withstands fires with less injury than other pines, and produces both naval stores and high-grade timber. Furthermore, cattle grazing can be combined with timber production in longleaf forests to enable farmers to make more profitable dual use of their land. This bulletin offers suggestions to farmers and other timberland owners for establishing and managing longleaf pine. The recommendations are based on the best available knowledge.

RESULTS OF THINNING A SPRUCE-FIR STAND

By M. W. Day. Mich. Agr. Expt. Sta. Quart. Bul. 36: 270-274. 1954.

A series of thinning plots, one-fifth acre in size each, was established in 1940 in a 30-year-old spruce-fir stand to determine the response to different degrees of thinning. Re-measurements have now been made at 5 and 10 years after thinning.

Three plots were thinned to spacings of 6 x 6, 8 x 8, and 10 x 10 feet or actually to 1, 210, 680, and 440 trees per acre. The best growth was obtained with the 8 x 8 spacing.

Growth on the control plot has remained relatively high in comparison with that on the thinned plots. However, it is pertinent to point out that growth on the control plot was practically the same during both 5-year

periods, while on the thinned plots growth during the second 5-year period averaged approximately 1-1/2 times that obtained during the first 5-year period. Total growth of the 8 x 8-spaced plot is computed at 19.2 cords, while that of the control plot is 12.4 cords, an advantage of 6.8 cords at only 10 years after thinning.

SUGGESTIONS FOR IMPROVING FARM WOODLOTS BY GIRDLING AND POISONING WEED TREES

By G. I. Garin and F. F. Smith. Ala. Agr. Expt. Sta. Leaf. 44. 1954.

Neglected woodlots need improvement work to restore their productivity. Defective hardwoods should be eliminated when they compete for growing space with good trees. Merchantable trees of low value can be sold for a low stumpage price. Large undesirable trees can be girdled; as a rule they do not sprout. Medium-sized trees can be poisoned with ammate in chopped cuts or in frills for hickories. They can be killed effectively also by using esters of 2,4-D and 2,4,5-T in frills. Small trees can be cut and ammate or other chemicals applied to stumps to prevent sprouting. This work can be done at a reasonable cost and it is an economically sound practice. Thus, woodlots of low productivity can be converted into stands of good trees that increase in value as they grow. When these trees are harvested either in intermediate thinnings or when they reach maturity, they will pay good dividends to the owner.

EFFECT OF SEEDBED CONDITIONS ON PAPER BIRCH REPRODUCTION

By R. J. Hutnik. Jour. Forestry 52: 493-495. 1954.

The condition of the seedbed is partly responsible for paper birch not becoming established in some areas. As yet there is no sure way of getting paper birch reproduction. But by completely removing the overstory and exposing the mineral soil, good seedbed conditions can be created. This can be done by clear cutting, summer logging, tractor skidding, disking, or even controlled burning.

FLORISTIC ANALYSIS OF GROUND COVER VEGETATION BY A RAPID CHAIN METHOD

By S. A. Wilde. Jour. Forestry 52: 499-502. 1954.

The failure of technical workers to take advantage of site indices written by nature may be traced to the lack of a simple and rapid procedure for quantitative floristic analysis. This paper aims to alleviate this deficiency in a certain measure and reports an adaptation of the lime transect method, which was found to possess definite merits in several trials.

The results of quantitative floristic analyses provide objective information on the composition of the characteristic ground-cover associations and indicators significance of different species. This information in turn serves as a guide in the survey of forest lands; it helps to establish ecologically important soil units, reduces the number of necessary borings and profile excavations, facilitates the delineation of soil-type boundaries, and often reveals the concealed properties of soil, such as erratic intrusions of boulder clay, calcareous substrata, and deep ground-water table. In mensuration studies and silvicultural work employing sample plots, results of floristic analyses at times indicate the heterogeneity of the selected study areas in regard to soil properties or past history.

PLANTING BLACK LOCUST FOR FENCE POSTS

By J. R. Hamilton. Ga. Agr. Expt. Sta. Cir. 170. 1953.

The black locust produces wood which is second only to osage-orange for durability when in contact with the ground, and may be grown successfully in many sections. These characteristics indicate there is the possibility of landowners growing this tree on their farm for the production of fence posts. Research indicates early growth of black locust is very rapid when grown under the proper conditions and locust posts may be grown on the farm in a relatively short time. The growth of black locust is stimulated by applications of fertilizer and by proper cultivation and pruning. The growth

of black locust is also greatly increased when grown on better soils. The cultural operations required and the best procedures to follow when growing black locust are given in detail.

SOME SILVICULTURAL PROBLEMS OF THE NORTHERN GREAT PLAINS

By E. J. George. Jour. Forestry 52: 511-514. 1954.

The silvicultural problems of the northern Great Plains are many and vary from year to year. The difficulties do not dampen the interest in planting trees in an area where success is not measured in board-foot volume but in contributing to the building of permanent and more pleasant homes and making possible the performance of farm duties during the winter months.

VARIATION IN NITROGEN, PHOSPHORUS AND POTASSIUM CONTENTS OF PINE NEEDLES WITH SEASON, CROWN POSITION, AND SAMPLE TREATMENT

By D. P. White. Soil Sci. Soc. Amer. Proc. 18: 326-330. 1954.

Important variations occur in potassium, nitrogen, and phosphorus contents of first-year pine needle tissue depending on the part of the crown sampled, the time of year, and the tissue-drying procedure. The primary aim of the study was to provide a basis for standardizing the sampling routine in collecting pine needles for foliar analyses. Several plantations in New York were systematically sampled and analyzed by standard chemical procedures to obtain data on the magnitude of these variations which have been observed by some workers, yet often ignored in tree-nutrition studies.

The data confirm previous observations of the percentagewise decline of potassium, nitrogen, and phosphorus in needle tissue from an early summer maximum to a fairly constant base level during the winter months. Late fall and winter sampling is recommended for foliar analysis of pine tissue. At this season, the needles are likely to be least affected by confounding physiological changes, and are also more expressive of soil fertility levels and species norms. Midcrown positions are recommended as expressive of crown means, whereas aspect is not considered important. Stripping of needles from branches and immediate oven-drying (70° C.) after collec-

tion are necessary. Important dry-weight losses in tissue which result in increases in nutrient percentages may occur in material which is allowed to air-dry.

SITE QUALITY FOR DOUGLAS-FIR IN SOUTHWESTERN WASHINGTON AND ITS RELATIONSHIP TO PRECIPITATION, ELEVATION, AND PHYSICAL SOIL PROPERTIES

By W. H. Carmean. Soil Sci. Soc. Amer. Proc. 18: 330-334. 1954.

The objective of this study was to determine the effects of soil, climate, and topography on the growth of Douglas-fir (*Pseudotsuga menziesii* var. *menziesii* (Mirb.) Franco) in southwestern Washington. The results indicate the productive capacity of forest land in this area in terms of permanent mappable features of the forest environment.

One hundred and fifty-five even-aged, second-growth stands of Douglas-fir were sampled. Total age and total height of dominant trees, slope, aspect, and topographic position were recorded. Descriptions of soil depth, soil consistence, elevation, and total annual precipitation were also made. Moisture equivalent and gravel content were determined for all soil horizons and in addition, the imbibitional water values of the substratum (C horizon) were measured.

The physical soil values and observed stand characteristics were assembled in a multiple regression that expressed tree height in terms of tree age and associated quantitative environmental conditions. The results of this statistical analysis are as follows: (1) Site quality decreases with an increase in elevation and with an increase in the gravel content and compaction of the soil layers above the substratum. (2) Site quality increases with an increase in total annual precipitation and with an increase in depth to the substratum. Increased site quality also occurred with an increase in the product of moisture equivalent and gravel content of the soil layers above the substratum thus indicating that the adverse effect of gravel is not as pronounced with fine-textured soils. (3) The above relations are expressed by means of regression equations calculated for each of five different soil groups. Site tables suitable for field use in the identification of Douglas-fir site quality may be prepared from these equations.

FOREST FLOOR IN THE PIEDMONT REGION OF SOUTH CAROLINA

By L. J. Metz. Soil Sci. Soc. Amer. Proc. 18: 335-338. 1954.

The annual litter fall, weight of forest floor, and organic-matter incorporation in the surface foot of mineral soil are reported for 3 pine, 3 pine-hardwood, and 3 hardwood stands in the South Carolina Piedmont.

The litter fall for the stands averaged 4,400 pounds per acre of which 3,500 pounds was leaf material. The weight of the forest floor was greatest in the pine stands and least in the hardwoods. The forest floor weight, expressed on a volatile matter basis, ranged from 6,160 pounds per acre in an old hardwood stand to 16,430 pounds in a 40-year-old shortleaf pine stand. The organic-matter content in the surface foot of mineral soil ranged from 83,550 pounds per acre in the old hardwood stand to 25,780 pounds in a young loblolly pine plantation. The weight of the forest floor and organic matter in the mineral soil shows that decomposition is more rapid beneath hardwood stands. The forest floors are classified as to humus type and the discussion presented shows some practical application of the information to forest-management work.

THE PLACE OF INDIVIDUAL-TREE DATA IN ESTIMATING GROWTH

By C. A. Bickford. Jour. Forestry. 52: 423-426. 1954.

The use of individual-tree data in forest survey effected a significant reduction in sampling error. However, gathering such data increases the costs of the survey by about 30 percent. Keeping individual records of all trees on all sample plots is not worth the extra cost for accurate estimation of periodic net change.

The best solution seems to be a compromise: To take individual-tree data from a sample of trees on the plots, rather than to identify all individual trees or none at all. This procedure takes advantage of the high correlation of volume growth over estimated diameter growth, and it avoids the extreme cost of mapping or tagging all trees on a plot.

ECONOMICS

HOW DISPOSITION OF CROPS AFFECTS THE ECONOMICS OF SOIL CONSERVA- TION

By R. H. Blosser. Jour. Soil and Water Conserv. 9: 169-174. 1954.

The economics of conservation farming is influenced by disposition of crops. In some areas livestock is necessary to provide sufficient farm income, even under soil-conserving farming. On many farms soil-conserving farming can increase net income by (1) higher returns per hour of labor, and (2) making possible the use of more labor and capital. When forage was fed to cows producing 5,000 pounds of milk for sale, soil-conserving farming gave \$897 more net income than soil-depleting farming, but required more labor and capital. When forage was fed to cows producing 9,000 pounds of milk for sale, soil-conserving farming gave \$1,270 more net income than soil-depleting farming. More labor would be required, but no more capital would be needed.

ECONOMICS OF SOIL CONSERVING PRACTICES ON MUSKINGUM AND ASSO- CIATED SOILS IN OHIO

By R. H. Blosser. Ohio Agr. Expt. Sta. Res. Bul. 746. 1954.

Net income from soil conservation practices used on Muskingum and associated soils is influenced by (1) disposition of crops, (2) type of livestock, and (3) efficiency of forage-consuming animals. Costs and returns for a group of soil-depleting practices were compared with two different groups of soil-improving practices. Where all crops were sold, net income was \$506 for "soil depleting" and \$1,711 for "soil conserving" farming with corn. When all crops were sold "conservation farming without corn" gave a net income of \$1,057 or \$551 more than "soil depleting farming". When forage was fed to dairy cows producing 5,000 pounds of milk for sale, net income was \$1,661 for "depleting" and \$2,558 for "conserving" farming.

BIOLOGY

CORRELATION OF WILDLIFE MANAGEMENT WITH OTHER USES ON THE PISGAH NATIONAL FOREST

By D. J. Morriss. Jour. Forestry 52: 419-422. 1954.

Each acre of forest land has a production capability which is fixed in the sense that it can be economically maintained but not increased rapidly. It will produce so much, but no more, plant material. The portion of this material used to produce animals cannot, of course, be otherwise utilized, such as for pulp-wood or lumber. When the stand is very young, however, the acre supports thousands of stems that cannot be carried to a commercial product size. Some of the excess can be converted into meat; some is useless except as soil cover. The answers to many multiple land-management problems are in the future, but some progress is being made in the reduction of low-value cover and in improvement of total usable production of

forest products, including wildlife. The key is sympathetic study of the problems of the wildlife manager by the forester, and vice versa. The result, as demonstrated on the Pisgah, is a mutual interest in total land management which comes with the full understanding that intelligent management of one potential resource can usually be made to benefit all of the others.

QUAIL MANAGEMENT ON FORESTED LAND

By P. Goodrum and V. H. Reid. Jour. Forestry. 52: 518-520. 1954.

Food-habit studies, ecological investigations of quail food plants, quail inventories, and experimental demonstrations on heavily cutover and forested longleaf pineland show the practicability and feasibility of quail management on this type of forest land. There appears to be less conflict with quail management and forestry and grazing on forest land than on farmland.

